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THE JOURNAL OF MYCOLOGY:

DEVOTED TO THE STUDY OF FUNGI,

ESPECIALLY IN THEIR RELATION TO PLANT DISEASES.

PREPARED, UNDER THE DIRECTION OF THE SECRETARY OF AGRICULTURE,

BY

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INTRODUCTORY.

As has already been announced, the JOURNAL OF MYCOLOGY will henceforth be published by the Section of Vegetable Pathology, and will be issued quarterly instead of monthly.

The publishing of this journal is something of a departure from the work ordinarily done by this Section, and has been undertaken for somewhat different purposes.

The growth of the study of Mycology during the past twenty years has been phenomenal, and as it forms the very foundation for that more practical study, the proper means of combating the parasites which are causing such serious losses to cultivated plants, it seems highly proper that the Department at Washington should furnish all the stimulus possible for the prosecution of the study.

The law establishing experiment stations makes special mention of the study of plant diseases. In some stations work in this direction has already been started, and more will probably be undertaken in the near future. The literature on this subject is scattered through many journals and papers in half a dozen languages. It is not, therefore, easily accessible or procurable by the stations, and is altogether out of the reach of many private workers in this field. These and other reasons have made it seem desirable to bring together in some regular publication the latest and best knowledge of mycological experts, together with some account of the most important literature.

From what has been said it is apparent that the aim of this publication will be to reach and assist the workers in this difficult field rather than to prepare matter more directly for the general reader. The latter is already provided for by the issue of bulletins and in various other ways, both by this Department and by the stations themselves.

PERONOSPOREÆ AND RAIN-FALL.

By Byron D. Halsted.

The chief point in this paper is to contrast the prevalence of the *Peronosporeæ* during the past year with the quite general absence of them the two previous years. It will be necessary to state the leading difference in the rain-fall of the last two years, and as this is the only apparent element of variation, except in so far as this modifies other meteorological conditions, it is only natural to attribute the variations in amount of mildew largely to the difference in the rain-fall.

The year 1887 was an exceedingly dry one and the last growing season has been not far from the average one in moisture. In 1887, according to the weather record kept at the college (Ames, Iowa) and kindly furnished me by Professor Osborn, the showers in time and amount were as follows:

	Inches.		Inches.
Mar. 5	.10	July 17	.02
Mar. 27	.56	July 18	.30
Apr. 23	1.26	July 19	1.45
Apr. 26	.02	July 22	.13
May 14	.16	July 30	.41
May 22	.08	Aug. 5	.23
May 29	.15	Aug. 9	.11
June 6	.02	Aug. 10	.08
June 11	.20	Aug. 18	.09
June 12	.43	Aug. 20	.40
June 13	1.16	Aug. 21	.08
June 20	.23	Aug. 26	.10
July 13	.45	Aug. 30	.08
July 16	.02		

By month this gives for—

	Inches.		Inches.
March	.66	June	2.04
April	1.28	July	2.78
May	1.39	August	1.17

This is an average of only 1.39 inches per month and a total of 8.32 for that half of the year when rain is most essential for the existence and growth of vegetation. This prolonged drought was made more intense by the preceding dry year. It was in fact the second of two comparatively rainless seasons. September opened with refreshing showers, and by the close of the month the rain-fall amounted to nearly 10 inches (9.77).

For six months in 1888 the rainy days were as given below:

	Inches.		Inches.
Apr. 26–29	1.22	July 4–5	1.86
May 3-4	1.51	July 16	1.73
May 7–9	1.47	July, scattering (3)	.58
May 27–28	1.11	Aug. 5–6	.37
May, scattering (3)	.46	Aug. 10	.65
June 1	.38	Aug. 14-15	1.38
June 12	.17	Aug. 28	.14
June 20–21	1.19	Sept., scattering (4)	.16
June 27	.66		

By month this gives for—

	Inch.		Inch.
April	1.22	August	2.54
May	4.55	September	.16
June	2.40		
July	4.17	Total	15.04

It will be noticed that while in 1887 there were only three rains of over an inch in the growing season, during the past year the record shows seven. The most marked difference was in May, when 4.55 inches of 1888 stands in contrast with 1.39 inches of 1887. It should be kept in mind that May is the time when rains, if not in excess, do the greatest amount of good, as vegetation then is in a condition to profit most from showers. The amount in June remains about the same, but that for July and August is nearly double. The species of *Peronosporeæ* are taken up one by one, as this seems the best method of exhibiting the contrasts.

PHYTOPHTHORA INFESTANS, DBY. Three years ago, after an average season, there was much complaint of the rot in all parts of Iowa, and housed tubers contained the parasite in abundance. The potato crop for 1888 was very heavy, and no rot has been seen by or reported to me. The two very dry years, viz, 1886 and 1887, doubtless have greatly reduced the number and vitality of the rot spores, and done more than an average season to rapidly develop the rot.

PERONOSPORA VITICOLA, DBY. None of this mildew of the grape was found last year, although the search for it was frequently made, and in places where two years before the wild canes of *Vitis riparia*, were dwarfed and covered with a thick white felt down to the earth's surface. No signs of the mildew could be found in the large college vineyard, where many sorts of cultivated grapes and a few scattered vines of native wild species are grown. The vines were in every way healthy, and flourished when all vegetation about them was suffering with drought and heat. This season the cultivated vines suffered severely from the mildew, and nearly every leaf was more or less affected and the crop much injured.

PERONOSPORA HALSTEDII, FARLOW, is the most wide-spread species in Iowa. Its hosts are numerous, the leading ones of which are several species of *Helianthus*, *Silphium*, *Eupatorium*, *Bidens*, and a long list of other genera all of the order *Compositæ*. In 1886 this mildew was moderately common, but last year it was found only upon those composites which were in wet places. It was rare upon *Helianthus*; not found at all upon *Ambrosia artemisiæfolia*, *Solidago Canadensis*, or *Eupatorium* and *Silphium* species. In short, the genus *Bidens* was the only one which could furnish any considerable supply of specimens. *B. frondosa*, *B. chrysanthemoides*, and *B. connata*, var. *comosa*, all were infested, but these hosts grew in beds of streams where plenty of moisture reached the rank succulent plants. This year there has been a fair quantity of the *Compositæ* mildew upon the high-ground plants, especially about the middle of June, which may be accounted for by the May rains.

PERONOSPORA OBDUCENS, SCHRŒT, upon *Impatiens fulva*, has not been met with during the last three years. It is not a common species in the most favorable season.

PERONOSPORA GERANII, PK., was not found last year upon the common host *Geranium maculatum*, but in May was collected by A. S. Hitchcock upon *Geranium Carolinianum*, at Iowa City. During June of 1888 the mildew was very abundant upon *G. maculatum*; in fact, more so than any other species at that time.

In May last a *Peronospora* was found upon the common water leaf (*Hydrophyllum Virginicum*). I am not aware that Dr. Farlow, to whom specimens were sent, has determined the species. It was growing over the same areas, and closely associated with the Spotted Cranesbill affected with *P. geranii*. It is very interesting to note that the same species was first discovered by Mr. Holway about a fortnight earlier, at Decorah, Iowa, and also found by Mr. Hitchcock, of Iowa City, at almost the same time as at Ames.

PERONOSPORA PYGMÆA, UNGER, on *Anemone* sp., was not observed last year, but in 1888 it flourished in late May and early June.

PERONOSPORA GANGLIFORMIS, DBY., occasionally appeared upon the lower leaves of *Mulgedium leucophæum*, in 1887. The other hosts prefer dry ground, and in their dwarfed condition were not infested. During the year just closed it could be said to be common upon *Prenanthus* and *Lactuca* hosts.

PERONOSPORA PARASITICA, TUL., is one of the most common species upon various cruciferous hosts. In ordinary seasons *Lepidium Virginicum*, is badly infested, having its branches strangely distorted. Last year the pepper-grass was quite free from the parasite, if we except the seedlings, which were attacked for a few weeks in spring. The *Peronospora* was most abundant upon *Nasturtium palustre*. In June the lower leaves of the host, lying close to the moist ground of borders of streams, were quite generally affected. A little later, when the drought had progressed, it was not abundant. In some specimens the conidiophores were not more than one-fourth the normal size. Early in 1888 the mildew was abundant upon the pepper-grass, and continued so until July.

PERONOSPORA POTENTILLÆ, DBY., was common on *Potentilla Norvegica*, early in 1887, when the host was growing on the borders of low wet places. It disappeared as the dry weather of late spring arrived. Last season it did not appear in abundance until July, when whole large plants were found attacked.

PERONOSPORA ARTHURI, FARLOW, was not common three years ago, but during 1886–'87 it was found only on a few plants growing along the shady bank of a stream. It has not been common the last season and is peculiar in only attacking here and there a whole plant.

PERONOSPORA EFFUSA, RABH., is a common species upon *Chenopodium album*, but was far less abundant than usual during the two dry seasons.

PERONOSPORA POLYGONI, THÜM., is rare on *Polygonum dumetorum*. Mr. Hitchcock found the mildew upon *P. aviculare*, at Iowa City in May of 1887, but it was not at all common. It was abundant upon *P. convolvulus* in July of the last season.

PERONOSPORA ALTA, FCKL., has been almost entirely absent from *Plantago major*, for the last three years. In 1885 it was one of the easiest of the Peronosporas to obtain in quantity.

PERONOSPORA TRIFOLIORUM, DBY., has heretofore been one of our most common species upon *Astragalus Canadensis*, and especially on *Vicia Americana*. Upon the latter two years ago it was so abundant as to almost destroy the host in whole patches. It was found in 1887 only after diligent search in the moistest places where the vetch will grow. It again appeared in 1888 but in milder form than before the dry years.

PERONOSPORA EUPHORBIÆ, FCKL., is a species which quickly disappears in times of drought. It is not uncommon on *Euphorbia maculata*, in a wet season, but rare indeed in 1887. The usual amount was met with in 1888 noticeably dwarfing the small leaves of the host.

PERONOSPORA LEPTOSPERMA, DBY., was common in 1885 on both *Artemisia biennis* and *A. Ludoviciana*. During 1887 it was met with in only a few places on *A. biennis*, growing in moist spots near excavations along a railroad track. Last season found it abundant again.

PERONOSPORA SORDIDA, BERK., is a good illustration of the influence of moisture upon the development of *Peronosporeæ*. The host *Scrophularia nodosa* is a common plant on the banks of streams, especially where the surface is without sod. In 1887 the mildew was abundant in only one place—a bend of a stream where the host grew close to the water and could obtain moisture freely. It was not at all uncommon during the last growing season.

PERONOSPORA LOPHANTHI, FARLOW, on *Lophanthus scrophulariæfolius*, is a rare species in Iowa and was met with only in 1887.

PERONOSPORA GRAMINICOLA, SCHRŒT., which was abundant in 1886 upon *Setaria viridis*, transforming the inflorescence of the grass into strange shapes, was far less common during 1887. Last autumn it infested the foxtail quite generally and appeared to some extent upon the Hungarian grass. This new parasite may do much mischief in the future.

PERONOSPORA CALOTHECA, DBY., is not rare upon species of *Galium*. In October, 1887, seedling plants, which had come up in a rich mold since the September rains, were badly infested. This is a good illustration of fresh, growing tissue being favorable for the development of *Peronosporeæ*.

The genus *Cystopus* has four species common to Iowa.

CYSTOPUS CANDIDUS, LÉV., like *Peronospora parasitica*, is confined to the *Cruciferæ*, and also like it lives over the winter within the tissue of the seedling plants. There was an abundance of the *Cystopus* on Shep-

herd's-purse seedlings in the spring of 1887, and it produced a large crop of spores which did not spread the trouble rapidly to other plants as in an ordinary season. In June there was very little of the mildew and only a few spots could be seen on the seedlings in the autumn. Only a small amount of the fungus was found the next spring. The mildew was fairly abundant upon the common pepper grass (*Lepidium Virginicum*), but soon disappeared. Three years ago in a moist season the blossoms, flower stalks, and seed vessels of the garden radish were generally attacked and often distorted beyond recognition. Very late in October, 1887, the mildew was found prevalent upon seedling plants of *Sisymbrium officinale*, which had developed after the September rains in a shady place. Last year there was very little of the mildew upon the Shepherd's-purse. The two dry years had done much toward eradicating it along with the host.

CYSTOPUS CUBICUS, LÉV., is the least common species of the genus, and for the last three years has been found upon *Ambrosia artemisiæfolia, C.*, only at rare intervals.

CYSTOPUS BLITI, LÉV., occurs upon an increasing list of hosts. *Amarantus blitoides*, was badly infested in all three seasons, and as this species flourishes in dry places, upon paths, and roadways it at first seems an exception to the rule. However, this Amaranth is thick-leaved and succulent, and like the purslane is full of moisture, even though the surroundings are arid. It was a fact of observation that the greatest development of the mildew was upon plants which were most favored with moisture and shade.

CYSTOPUS PORTULACÆ, LÉV., is the last species of the list and one of no little interest in the present connection. It seems to have been more abundant during the two dry seasons than before or since. The host is a juicy plant and the appearance of greater thrift on the part of the parasite may be due to the fact that it was more than usually destructive, the purslane not being able to withstand its attacks. Therefore a patch of the host while showing more of destructive effects of the mildew might in fact have less of the parasite. It is impossible to say there was more or less of the mildew the last year than the season preceding. These observed facts seem to show that with the *Peronosporeæ* there is no doubt that the species are best suited to a moist season. The members of the genus *Peronospora* have in no instance been so abundant during the two dry years as before or since the drought. In general the mildews were found in early spring in 1887, after this, through the long dry summer, in limited quantities, upon plants growing in moist places along streams and edges of pools. In 1888 the greatest abundance was in June after the May rains.

The genus *Cystopus* seems less influenced by drought, but as a rule the infected specimens were those best situated for obtaining moisture. In all cases where *Peronosporeæ* flourished in drought, they were upon succulent hosts, and even with these there was probably less growth of

parasite but a greater manifestation of disease due to lack of vitality in the hosts. These instances, therefore, form no exception to the general rule, that dry weather is not advantageous for the development of the *Peronosporeæ.*

In preparing this paper the writer has drawn freely upon his article "Downy Mildews in a dry Season" in Ames' (Iowa) College Bulletin, 1888, which gives an account for the years 1886 and 1887, and in some instances the form of statement therein used is here reproduced.

AN INTERESTING UROMYCES.

By Byron D. Halsted.*

The following description is of a *Uromyces* collected the past autumn, which has the habit of infesting the perigynia of a sedge, causing them to assume a quite unnatural dark color before their time of maturing.

Uromyces perigynius, Halsted. Sori one-half to 2^{mm} in diameter, forming dark-brown, nearly globular patches upon the outside and between the veins of the perigynia, not infrequently upon both surfaces of the younger leaves, where the patches are often three times as long as broad. Teleutospores somewhat variable, 4–6 by 8–10μ, with a prominent brown free end ranging from acute to wedge shaped. Contents usually granular and often with a large oil globule. Pedicel two to three times the length of the spore, slender and hyaline.

On *Carex intumescens*, near Ames, Iowa, September, 1888. D. G. Fairchild.

The other known species of *Uromyces* upon *Carex* is *U. Caricis* of Peck (Mycotheca Universalis No. 746), which is very different in habit and characteristics of the spore. It is reported only upon *Carex stricta* and not upon the perigynia. In making the comparison it was interesting to observe that with *U. Caricis, Pk.*, there were ocasional double spores among those of normal form. Sometimes a half dozen adjoining spores in a partially crushed sorus would be of the puccinia type. Those who are subscribers to Ellis and Everhart's N. A. F. may expect the *Uromyces* above described in the next issue.

NEW SPECIES OF KANSAS FUNGI.

By W. A. Kellerman and W. T. Swingle.

Tilletia buchloëana *n. s.* In the much enlarged and mostly globular ovaries of *Buchloë dactyloides*, abnormally borne on the male plants; often all or nearly all the staminate spikelets produce the ovaries, all of which are infested. Spores dirty brown in mass, as seen

* Rutgers College, New Brunswick, N. J.

singly dusky or brownish fuscous, never very dark, perfectly spherical or very slightly oval, regular in size, 16½–21μ diam., but mostly 18–20μ (exclusive of hyaline envelope). The outer wall of the spores is marked with scattering, regular spines or faint reticulations (formed by coalescence of the spines?) ½–1½μ high, but completely enveloped by the outer hyaline layer, which is 1½–4μ thick. The outer wall is about 1½–2μ thick, and is the darkest colored part of the spore; immediately within this is a thinner, clear, lighter colored wall ¾–1μ thick; following this is a layer of variable thickness, usually finely but sometimes coarsely granular. In the center of the spore is a very light homogeneous usually spherical body 7–10μ, mostly 7½–9μ in diameter.

On male plants of *Buchloë dactyloides*, western and southwestern Kansas (Trego County, 1886, and Ford County, June, 1888).

In some cases, especially in young spores, the hyaline layer is seen to be made of two distinct layers, the inner extending from the wall to the tips of the spines and being slightly darker than the outer layer. The immature spores when placed in water become very much swollen and are almost colorless, except the collapsed central body. Mixed with the spores were seen in many cases a hyaline, branched, septate mycelium, 3–4½μ diam., but whether connected with the spores or not can not be said. Attempts to induce germination of the spores failed.

The infected plants are easily detected by their apparently denser and darker inflorescence, but the monstrosity consists solely in the production of ovaries in the male plants. These are in every case filled with the mass of spores and are very much enlarged pushing the glumes wide apart. In size the smutted ovaries are 1.3–1.8 by 0.6–1.3^{mm}. The few female plants collected in the same localities were free from the fungus. Figs. 1–11.

USTILAGO ANDROPOGONIS, *n. s.** In the ovaries of *Andropogon provincialis* and *A. Hallii*, not only the sessile flowers (which are perfect), but also the pedicelled ones, which are normally staminate, often produce the cylindrical elongated infested ovaries; spores in mass intensely black, as seen singly dark brown or black, subglobose or slightly oval, sometimes oblong elliptical or ovate, slightly angular. Wall thick (¾–2μ, mostly 1½μ) very finely and closely echinulate. Contents coarsely and evenly granular or sometimes homogeneous, 12–19μ by 9½–16μ, mostly 13½–15½μ by 11–14μ.

* Since sending the description of this species to the printer we have received Ellis & Everhart's North American Fungi Cent. XXIII. No. 2265 *Sorosporium Ellisii*, var. *occidentalis*, on *Andropogon furcatus*, Bismarck, Dak., August, 1884, A. B. Seymour, is the same as *Ustilago andropogonis*, Kell. & Sw. The Dakota specimens were examined by us as were the youngest Kansas specimens (collected June 26, 1888) but in none could the spore masses characterizing *Sorosporium* be seen. Besides, the spores are larger and different in color, shape, thickness, and character of wall, number and size of spores, etc., from *Sorosporium Ellisii*. The species as far as can be determined without a knowledge of the germination of the spores certainly seems to be a good *Ustilago*. No. 2265, *b*. N. A. F. on *Andropogon Virginicus*, Newfield, N. J., is apparently different from the above and a true *Sorosporium*.

The spores found on *Andropogon provincialis* are somewhat narrower and longer than on *A. Hallii*, and more often oval than subglobose. They were also more variable in size and shape. On *A. provincialis* the spores were 12–19 by $9\frac{1}{2}$–$13\frac{1}{2}\mu$, mostly 13–16 by 10–$13\frac{1}{2}\mu$, while on *A. Hallii* they were 13–$18\frac{1}{2}$ by 11-16μ, mostly $13\frac{1}{2}$–15 by 13–14μ. Attempts to induce germination failed.

Southwestern Kansas, June, 1888. On *Andropogon Hallii*, Seward County, June 26, and on *A. provincialis*, Harper County, July 14, 1888. The affected ovaries on *A. provincialis* are 2.5–7 by 1.2–8^{mm}, and those *A. Hallii*, 6–8 by 1.4–8^{mm}.

This species is clearly distinct from *Ustilago Ischaemi* Fckl., and *U. cylindrica*, Pk. both in size of spores and in being confined to the ovaries. Figs. 12–26.

USTILAGO BOUTELOUÆ *n. s.* In the enlarged ovaries of *Bouteloua oligostachya*; spores in mass, brownish; when seen singly, dark brown or sometimes light brown, oval, subglobose, or elliptical, regular or sometimes slightly angular; wall thin (about $\frac{1}{2}\mu$) irregularly, rather sparingly, tuberculate–echinulate (spines short, $1\frac{1}{2}$–3μ apart); contents homogeneous or often containing a single large granule, 8–12 by 6–10μ, mostly $8\frac{1}{2}$–10 by 8–$9\frac{1}{2}\mu$. Germination in water by means of a septate promycelial tube bearing one or two elongate cylindrical sporidia just below the septa at the end. Promycelial tube simple or rarely branched, hyaline, 2–4 septate, 25–50μ by 2–4μ. Sporidia cylindrical, ends subacute, hyaline, 9–13μ by 2–$2\frac{1}{2}\mu$.

Mixed with the spores in some cases were seen hyaline bodies of varying sizes composed of cells somewhat smaller than the spores, arranged in a sublinear manner. The spores germinated readily in water at a temperature of 37° C. and the promycelial tubes often separate readily from the spores when they have attained their growth. The sporidia were observed budding in a few cases.

On *Bouteloua oligostachya*, Manhattan, Kans., autumn and winter, 1888. In many cases the affected plants could be detected at a glance, as the spikelets were retained long after they had fallen from the healthy plants. The smutted ovaries are 1.5 – 4.6 by 0.8 – 1.7^{mm}.

The grasses attacked by the three preceding species of fungi are important for the West. They furnish a very large part of the pasturage, and even a considerable portion of the hay crop. The smuts, preventing the formation of seed, will therefore, when abundant, likely do damage of much consequence.

ÆCIDIUM DALEÆ *n. s.* Spots none; æcidia on the leaflets or rarely on the petioles, mostly hypophyllous but often also sparingly epiphyllous, numerous, crowded, occupying from a third to the whole of the leaflet, which becomes yellowish in color as far as attacked. Peridia white (or pinkish?), usually slender ($\frac{1}{5}$–$\frac{1}{3}^{mm}$ diameter), of moderate length ($\frac{1}{6}$–$\frac{1}{3}^{mm}$), cylindrical or very often constricted above, open from the first, never hemispherical; margin crenate, subentire, or crumb-

ling or lacerated into many short erect or slightly reflexed segments. Peridial cells, below small and polygonal, above very large and having a flattened conical portion projecting outward and upward from the inner side, sometimes containing a few yellow granules, 18–42 by 15–36μ, wall 2–5μ thick, conspicuously tuberculate, the warts forming short lines or clusters on the surface. Spores yellow or at length pallid, subglobose or oval, regular or slightly angular, 23–32 by 18–25μ, mostly 24–28 by 21–24μ, wall 2–4μ thick, marked with both very fine warts and short, very blunt, round tubercules 1–2μ in diameter, which are wanting on the two attached surfaces but extend around the spore in a band, becoming closely crowded midway between the attached surfaces. Spermogonia amphigenous, scattered, immersed, globose or flask shaped, about 100μ in diameter, scarcely visible except in section.

On *Dalea laxiflora*. Rockport, Rooks County, Kans., June 12, 1888, E. Bartholomew, No. 228.

This is a peculiar and well-marked species. The upper peridial cells on the inner surface overlap somewhat like the scales of a fish, but also project outward. They are also remarkable for their great size. When the æcidia occur on the petioles they cause an enlargement, but on the leaflets scarcely any thickening can be observed. Mr. Bartholomew remarks that the species is "very abundant, making many of the host plants entirely abortive."

A STUDY OF THE ABNORMAL STRUCTURES INDUCED BY USTILAGO ZEÆ MAYS.[1]

(Plates II, III, IV, V, VI, VII.)

By Etta L. Knowles.

The fungus known as *Ustilago Zeæ Mays* is found on Indian corn everywhere. It appears in stem, leaf, grain, and in both staminate and pistilate flowers, producing an abnormal growth of tissue sometimes as large as a man's fist, whitish at first but black when the spores ripen, which is about the time of the ripening of the corn.

In order to understand the changes which are produced by the fungus, a careful study was at first made of the normal structures. Alcoholic material gathered July 19, 1887, was used for this purpose and also for the study of the abnormal structures. Schulze's solution was used for staining the sections and glycerine for mounting them. The drawings were all made with a camera and are on the same scale.

Upon examining the stem it was found to consist of an epidermal system and scattered fibro-vascular bundles, of a somewhat oval form in cross section, between which were the rather large cells of the ground

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[1] This work was carried on under the direction of Prof. V. M. Spalding, in the botanical laboratory of the University of Michigan, 1888.

tissue. The latter were hexagonal in cross, and rectangular in longitudinal section, Figs. 1 and 2. Their walls are rather thick and contain numerous thin places which are elliptical in form and lie with their long axes perpendicular to the axis of the stem. Many of these seem to have broken through and formed openings from one cell to the next. The intercellular spaces are small. The size of these cells varies with their position, those midway between two bundles being larger than those immediately adjacent to them.

The bundles are scattered through the ground tissues at somewhat regular intervals, always with the phloëm turned toward the epidermis. Near the periphery of the stem they are packed more closely together, with very little of the ground tissue between, Fig. 3. They are of the form known as the closed collateral bundle. Within the xylem and toward the inner side of the bundle is a space, Fig. 4, *a*. Partially surrounding it is the xylem parenchyma, which is composed of small elements with thinner walls than are found in the adjacent tissue. Back of this canal and partially projecting into it is an annular vessel, *b*. At each side of the bundle is a large duct, *c*, with thick reticulated walls. Between the ducts and back of the annular vessel are thick-walled elements, the tracheides. Between the tracheides and ducts and the external part of the bundle is the phloëm *d*, consisting chiefly of sieve tubes and cambiform cells. The latter, small, thin-walled, square, or rectangular, sometimes narrow or obliquely four sided elements, are distributed among the sieve tubes, which are rather large, thin-walled, polygonal elements. Both sieve tubes and cambiform cells are filled with a granular protoplasm. The elements of the bundle sheath *e* have thick pitted walls. It is developed best at the ends, particularly at the outer end, where it may consist of several layers. At the sides it often borders directly on the ducts. In longitudinal sections, Fig. 5, all of the elements are found to have transverse septa, except those of the bundle sheath, in which they are oblique. The sieve tubes are longer than the cambiform cells, and have the characteristic callous plates. The annular vessels are seen to consist of a very thin-walled portion, which is held open by thick rings placed at nearly regular intervals, *g*. The bundles just under the epidermis are usually somewhat different from those just described in that the larger intercellular space is partially or wholly absent.

The epidermis is made up of cells, which are represented in cross section in Fig. 3, *a*, in longitudinal section in Fig. 6, *a*, and in surface view in Fig. 7, *a*. As seen in the two latter they are elongated cells with slightly sinuous outline and thick pitted walls, the outer of which is somewhat the thicker and covered with a thin cuticle. In longitudinal sections and in those which show surface views there are seen to be two kinds of cells, those already described and short cubical cells. The latter are found usually one at each end of a long cell, but sometimes there are several of them together. The sub-epidermal tissue consists of

several layers of sclerenchymatous elements, Fig. 3, *b*, which are similar in appearance to those of the bundle sheath. Numerous stomata were found, each consisting of two guard cells, Fig. 7, *b*, and a pair of accessory cells, *c*. In surface view the former are dumb-bell shaped, fitting closely together at their ends, while the latter are nearly semicircular in outline.

Sections were then taken of a diseased portion of the same stem, of which the normal structure had been studied. The abnormal growth forms a more or less elongated mass at the side of the stem. Fig. 8 is a digrammatic representation of a cross section through a diseased portion, *b; a* represents the stem and *c* the outgrowth from it. The part of the stem at *b* seems to be little changed in structure, but at *a* quite the reverse is seen. At the latter point the bundles especially were very much distorted, being swollen to several times their normal size through cell multiplication, and in longitudinal section those lying adjacent to *c* were seen to be sending numerous small branches into it. Getting a very early stage, Fig. 9, the first change noticed was a separation of the epidermis, together with its two or three layers of sub-epidermal tissue, *a*, from the parts lying directly underneath, by one or two layers of cells, *b*, similar to those of the ground tissue and containing starch grains. In the normal stem examined the sub-epidermal layers were so closely connected with the bundle sheath of the peripheral row of fibro-vascular bundles that no line of division could be traced separating the two. Taking sections where the distortion was in all grades of development, it was found that as the abnormal tissue developed this space increased, until, instead of one or two layers of cells, as at first, there was a mass of cells separating them, thick walled in early and thin walled in later stages. The walls of the epidermal cells also became thin. For the most part, then, the abnormal tissue appears to grow in between the epidermal system and the outer row of fibro-vascular bundles, the latter taking part to the extent of sending into it numerous branches. In order to accommodate this great increase of tissue, the epidermal cells stretch and divide and change their form from that seen in Fig. 7 to that seen in Figs. 10 to 14.

The stomata are distorted in the manner shown in Figs. 11, 12, 13, and 14. An attempt was made to trace the changes which take place in the accessory cells from the normal form seen in Fig. 7 *c*, to the distorted form represented in Fig. 14 *b*. Fig. 14 was from a section cut from a place where the spores were nearly ripe, while Figs. 11, 12, and 13 were taken from the surface of tissue which was not so well developed, and represent three forms intermediate between the normal form Fig. 7 and the distorted form Fig. 14.

The cells of the ground tissue were found to be different in form according to their position. Those in the region of active growth, that is, in the region adjacent to the normal part of the stem, Fig. 8 *d*, were seen to be of the form of those represented in Fig. 15, very thin-walled,

the long axes of the cells lying parallel to a tangent drawn to the nearest point of the original stem. Each was completely filled with material for growth. Passing farther out this form gradually changes first to that represented in Fig. 16, then to a form like those in Fig. 17, then to smaller cells again, and covering all the epidermal cells, as shown in Fig. 18. The cells described above all had thin walls, without pits or openings. In most of them the nucleii were very large and conspicuous, especially in those represented in Fig. 18. Abnormal fibro-vascular bundles ran through the tissue, and adjacent to them the cells of the ground tissue were elongated in the direction of the length of the bundle.

In Fig. 19 a bundle is represented in which the distortion has not been carried very far. It has become a little broader by cell-multiplication, and the xylem parenchyma and tracheides as well as all of the phloëm have become very thin-walled, and give the reaction for cellulose with Schultze's Solution. In the normal structure the two former were composed of liquefied elements. Large nucleii were observed in a great many of the cells of the xylem parenchyma and in one or two cases in the sieve tubes. The cells of the bundle sheath have multiplied at both ends of the bundle, and in a more distorted bundle than the one represented were seen to also have become thin-walled. In stages a little farther on, cells which looked like those of the ground tissue, and which were filled or partially so with starch, had grown in and separated the bundle into little groups or bundles of thin-walled cells. These branches passed out into the abnormal growth, and these branched again, forming altogether a sort of tree-like organ for the support and nourishment of the delicate tissue through which it runs. Figs. 20 *a* and 21 show longitudinal sections of the bundles as they appear in this tissue. They are composed of short, narrow, thin-walled cylindrical cells, arranged end to end. Nucleii are conspicuous in most of them, and all are filled with a finely granular substance which colors yellow with Schultze's Solution. In Fig. 21 the bundle has thrown off a slender branch at *a*. The walls of these cells had no markings, and the cells themselves appeared very much like cambiform cells, except that they were shorter, and contained conspicuous nucleii. In the normal tissue nucleii were not observed in either sieve tubes or cambiform cells. In some of the bundles similar to those figured in 20 and 21 there were one or two layers of cells at each edge of the bundle which were small and thin-walled, but showed reticulated and pitted markings. In Fig. 22 a cross section of one of these bundles is represented. In them the elements are so changed that phloëm can not be distinguished from xylem, and there are no large elements. Where the large pitted ducts run into the abnormal tissue, which usually they do not, they take a course separate from the bundles and have very grotesques forms, changing direction constantly.

The observations made upon the fungus which causes these changes

agree with the descriptions which have been repeatedly given of it. I consists of a thick-walled mycelium tube, the lumen of which is not con stant in diameter, but in some places widens out and in other places i almost or apparently quite closed. The thickness of the mycelium fila ment also varies constantly. These coarse, tough threads are found in different parts of the stem, some at the center, others nearer to the periphery, running between the cells or into them, and with their sharp end pushing directly through the thickest walls, Fig. 24.

In fruiting, the mycelium forms a great number of short slender branches. Great masses of these are found in little nests in the abnormal tissue, Fig. 20, also Fig. 8. They are more slender and delicate than the mycelium already described and are generally of quite irregular form. Fig. 23 represents a much branched mycelium filament, which appeared in a break in a section. It appeared to have pushed its way in between the cells and not to have penetrated them. The slender filaments of these masses swell up into a form like that represented in Fig. 25, except that in many cases—indeed in most cases—the filaments lose their individual form and are more or less blended in a gelatinous, shapeless mass. Rounded places with little masses of rich protoplasm, Fig. 25 *a*, indicate spores in an early stage of formation. All stages may be found in the same mass. Fig. 26 shows later stages, where the ends of the filaments appear club-shaped and within are seen the almost ripe spores. The mature spore, Fig. 27, is one celled with two walls; the outer thick, brown, and covered with spines. The inner delicate and transparent.

From the comparatively small number of species in which abnormal changes under the influence of parasitic fungi have been carefully studied, it is hardly possible as yet to venture on any general or theoretical statements concerning the pathological changes induced by such parasites. It seems best therefore, in the present instance, to simply recapitulate the injuries occasioned to the host by the fungus in question, since it is only by multiplied observations of the same kind that sufficient data can be gathered for a more general conception of the relations of parasite and host.

The changes observed in the stem of *Zeæ Mays* are briefly as follows:

An extraordinary hypertrophy of the parts of the host where spore formation takes place, the irregularity of which gives rise to peculiar and conspicuous distortion.

Microscopic examination shows: (1) Great multiplication of cells near the periphery; (2) decrease in thickness of cell walls and, in case of the bundles, of the size of the elements; in many cases a decrease in the size of the cells of the ground tissue also; (3) distortion of the stomata, particularly of the accessory cells; (4) a breaking up of the bundles and a changing of their elements, so that in many cases phloëm can not be distinguished from xylem; (5) a marked increase of cell contents.

SYNOPSIS OF NORTH AMERICAN SPECIES OF NUMMULARIA AND HYPOXYLON.

By J. B. ELLIS and BENJ. M. EVERHART.

[Continued from page 113, Vol. IV.]

Nummularia. Tul. Sel. Carp., II, p. 42. Stroma orbicular, cup-shaped or discoid, becoming black, marginate, the margin more or less distinctly sterile. Perithecia monostichous, peripheric, immersed. Asci cylindrical, 8-spored. Sporidia uniseriate, subelliptical, continuous, dark. The genus is too closely allied to Hypoxylon, especially the discoid forms.

A.—STROMA, CUP-SHAPED OR CONCAVE.

NUMMULARIA DISCRETA (SCHW.), Tul. Sel. Carp., II, p. 45 *Sphæria discreta*, Schw., Syn. N. Am., 1249. On dead branches and trunks of *Pirus Malus* and *Amelanchier Canadensis*, Newfield, N. J., on the first-named host, New England (Farlow), New York (Peck). On *Gleditschia triacanthos*, Ohio (Morgan), found also (Sacc. in Syll.) on *Sorbus*, *Ulmus*, *Cercis*, and *Magnolia*. Stroma erumpent, orbicular, 2–4 ^{mm}. diameter; cup-shaped, with a thick raised margin; dirty cinerous, then black, the concave surface at first white-punctate from the minute punctiform ostiola which in the mature state are scarcely visible. The wood beneath the stroma is marked with a black circumscribing line. Perithecia monostichous, ovate-cylindrical, nearly 1^{mm}. long, rather abruptly contracted above into a short neck, their rounded bases penetrating to the bottom of the stroma. Asci cylindrical, 110–120μ by 10–12μ. with long filiform paraphyses. Sporidia subglobose, nearly hyaline at first, finally opaque, 10–12 diameter. Sec. Cooke, Grev. XII, p. 6, the specimen of *Sphæria discincola*, Schw., in the Kew Herbarium, figured by Currey in Linn. Trans. 1858, Pl. 47, fig. 105, does not differ from *S. discreta*, Schw., but the *S. discincola* Schw. in Syn. Car. No. 63, and in Fr. S. M., p. 368, appears to be different, as may be inferred from the following description taken from Fries.

S. DISCINCOLA SCHW., Syn. Car. No. 63. Emersed-superficial, perithecia globose, crowded, black, truncate-annulate, covered with a cinereous white furfuraceous coat. Stroma irregular, subrotund, rugose, thin, penetrating deeply into the blackened wood. Perithecia scattered, rather large, urceolate, narrowed above into a minute round mouth, which is closed by white farinaceous matter. On the cut surface of trunks of apple trees in Carolina; rare.

NUMMULARIA REPANDA (FR.), *Sphæria repanda*, Fr. S. M., II. p. 346 *N. pezizoides*, E. & E., Bull. Torr. Bot. Club, XI, p. 74. On bark, Ottawa, Canada (Macoun.), on bark and wood, Topeka, Kans. (Cragin), and on bark of *Ulmus Americana*, Missouri (Demetrio). Found in Europe on branches and trunks of *Sorbus aucuparia*. Stroma erumpent-

superficial, orbicular, or subelliptical, ½–1^{cm}. diam., concave, and often with a thin, erect, rather broad margin, rufo-cinereus at first, finally black; disk mammillose from the projecting ostiola. Perithecia monostichous, immersed, ovateoblong ½–¾μ, long, crowded, often subangular from mutual pressure. Asci cylindrical, subsessile, 8–spored, 110–120μ by 8μ, with long filiform paraphyses. Sporidia obliquely 1 seriate, narrow ovate, obtuse, subinequilateral, dark brown, 11–14μ by 4–5μ (15–16μ by 6–7μ, Sacc. in Syll.). Distinguished from *N. discreta* by its mammillose disk and differently shaped sporidia.

NUMMULARIA EXCAVATA,* (SCHW.), Syn. N. Am. 1250. On bark of different species of *Prunus*, Bethlehem, Pa. (Schweinitz). Rather rare. Elliptic-orbicular, 1–2^{cm}. across, surrounded and margined by the raised but not radiately fissured epidermis. Disk deeply concave, black, punctulate, with many minute scattered depressions, in the bottom of which are the ostiola. The stroma is included in a peculiar black cup-shaped receptacle, which penetrates to the wood, and is filled in the lower part with a woody pseudo-stroma (altered substance of the bark), the upper part being the true stroma, in which nestle the rather large pyriform scattered perithecia, occupying the central part and attenuated above into a black shining neck. Sporidia short elliptical, dark brown, 11.5–015.3 by 009.6–001.5μ. Allied to the preceding species, but more rare.

NUMMULARIA SUBCONCAVA, (SCHW.), *l. c.* 1251. On branches of *Viburnum dentatum*, Bethlehem, Pa. (Schweinitz). Gregarious and often confluent, erumpent ¼–¾^{cm} across, surrounded by the ruptured epidermis, and consisting of a black crustaceous shell, inclosing the few rather large globose-depressed perithecia, connected by a very scanty stroma. Disk subconcave, subrugose, and black. Ostiola globose-papillate, elevated, few, black, sometimes confluent, connected by a very short neck with the perithecia, which have the ascigerous nucleus white. Sporidia oblong, light yellowish-brown, 15.3–019.2 by 005.76–007.6μ, some of them slightly constricted in the middle but not septate.

B.—STROMA CONVEX.†

NUMMULARIA BULLIARDI, Tul. Sel. Carp. ii, p. 43. *Hypoxylon nummularia*, Bull. Champ. tab. 468, fig. 4. *Sphæria clypeus*, Schw. Stroma at first covered by the epidermis, soon emergent, almost superficial and free, convex, orbicular or oval, rarely of irregular shape, sometimes broadly effused, black inside and outside, punctulate from the slightly

*We are indebted to our friend W. C. Stevenson, jr., who furnished the measurements of the sporidia in this and the next species, from an examination of the original specimens in the Schweinitzian Herbarium in the Academy of Natural Sciences in Philadelphia.

† Were we to rewrite this synopsis we would leave this section (B) of Nummularia in Hypoxylon, where it was formerly included, the difference being too slight to have any real generic value.

prominent ostiola, clothed at first with the rufo-ferrugineous conidial layer. Perithecia rather large, ovate, black, loosely included in closely packed cells in the stroma, something as in *Daldinia concentrica*. Asci cylindrical, briefly pedicellate, 100–115 by 10μ, with very long and stout paraphyses. Sporidia uniseriate, elliptical, hyaline at first, soon opaque, 12-15 by 7–9μ. The hymenium in this species, as in *Hypoxylon Petersii* B. & C., is at first covered by a carnose-coriaceous membrane, which soon disappears, except around the margin. Common on dead trunks and limbs of various deciduous trees around Newfield, N. J. Mostly confined to dead oak. Sec. Cooke in Grev. XII, p. 4, *Sphæria clypeus*, Schw. is different, but Schw., in his Syn. N. Am., gives *S. clypeus* as a syn. of *S. nummularia*, and there is nothing in his herbarium at Philadelphia to show that they are distinct.

NUMMULARIA GLYCYRRHIZA, (B. & C.), *Hypoxylon glycyrrhiza*, B. & C. Exot. Fungi Schw., p. 285. Suborbicular, margin thin, center subpulvinate, and marked with papilliform points (ostiola), which are depressed in the center. Perithecia oblong. On bark, Surinam, South America. Stroma pulvinate, 25 by 12^{mm}. Differs from *N. Bulliardi*, to which it is closely allied, in its oblong closely packed perithecia. The foregoing is the description of this species given in Sacc. Sylloge. We have seen no authentic specimen of this but one sent from Ohio (Morgan No. 284), supposed to be this, was submitted for determination to Dr. Cooke, who was inclined to regard it as this species. In the Ohio specimen the perithecia are a little over one half millimeter long and are rather narrower than those of *N. Bulliardi*. The ostiola also are rather less prominent and are mostly slightly collapsed. The spordia are oblong, pale brown, 2-nucleate, 10–11 by 4–5μ.

NUMMULARIA OBULARIA, (FR.) *Hypoxylon obularium*, Fr. Nova Symb., p. 130. "Immersum, erumpens, demum late effusum, determinatum, impolitum, stromate proprio atro, peritheciis immersis oblongis, ostiolis hemispherico-prominulis umbilicatis. Ad truncos arborum mortuos in Costa Rica, Oersted." Closely allied to *N. Bulliardi*, Tul., but differs in having its stroma connate with the matrix and inseparable from it, at first subrotund, then concrescent in a continuous crust, generally elongated; and ostiola depressed. The specimens examined by Fries were old and no trace of asci or sporidia remained. Cooke in Grevillea places this species in the preceding section, but there is nothing in the description to show that the surface of the stroma is concave.

NUMMULARIA MICROPLACA, (B. & C.). *Diatrype microplaca*, B. & C. Journ. Linn. Soc. x, p. 386. On *Sassafras officinale*. South Carolina (Ravenel) and Ohio (Morgan 261 and Kellerman 279). On *Persea*, Darien, Ga. (Ravenel F. Am. 255), *Anthostoma microplacum* (*B. & C.*) Sacc. in Syll. Stroma much the same as in *N. hypophlæa*, orbicular $\frac{1}{2}$–1^{cm} across, or elongated 1–2 by $\frac{1}{2}$–1^{cm}, thin, crustaceo-carbonaceous, black originating beneath the epidermis but soon bare, surface even, faintly punctulate from the minute ostiola, which are not prominent but slightly

depressed, as in *Hypoxylon punctulatum*, the opening at first filled with white farinaceous matter. Perithecia ovate-globose, small (less than one-half millimeter), monostichous. Asci (p. sp.) about 25 by 3μ, or with the short base 45–50μ long. Sporidia uniseriate, ends mostly slightly overlapping, sub-inequilaterally elliptical pale brown, 4½–5 by 2–2½μ. Berkeley says *N. hypophlœa* has larger ostiola and narrower sporidia. This is true as to, the ostiola, but as regards the sporidia the case is exactly the opposite. The wood beneath the stroma is stained with the same olive yellow color as the next species to which this is closely allied, but differs as stated.

NUMMULARIA HYPÓPHLÆA, (B. & RAV.) Grev. IV, p. 95, *ibid.* XII, p. 7. *Anthostoma hypophlœum*, Sacc. On dead trunks of *Magnolia glauca*, Newfield, N. J. (Ellis), South Carolina (Ravenel). Stroma thin, suborbicular ½–1^{cm} across, slate color, originating beneath the cuticle, which is soon thrown off, slightly convex, and faintly papillose from the slightly projecting ostiola. Stains the subjacent wood yellowish or yellowish olive. Perithecia in a single layer, ovate-globose, small (one-half millimeter), abruptly contracted above into a slender neck piercing the superficial carbonaceous layer of the stroma. Asci slender (100 by 4μ) with a thread-like base (p. sp. 55–60μ long). Sporidia uniseriate, lying mostly end to end, narrow, elliptical, pale brown, 2 nucleate, about 7 by 2½–3μ.

NUMMULARIA RUMPENS, CKE. Grev. XII, p. 8. *Diatrype rumpens*, Cke. Ann. N. Y. Acad. Sci., I, p. 185. On bark, Galveston Bay, Texas (Ravenel). Orbicular or elliptical ½–1^{cm} in diameter or by confluence 2^{cm} or over, and then more or less irregular in shape, thin, black, surrounded by the ruptured epidermis, roughened by the slightly prominent ostiola. Perithecia monostichous, ovate, ¾ millimeter high. Asci cylindrical, 100–115 by 10μ. Sporidia uniseriate, hyaline, then opaque, elliptical, with ends sub-acute or rounded, 12–15 by 7–9μ. This description is drawn from the specimens in Rav. F. Am. This seems to differ from *N. Bulliardi* in its less prominent ostiola and rather more acutely pointed sporidia; nor are there in the specimens we have seen any very perceptible remains of the overlying membrane. In our collections are specimens of what appears to be the same as those in F. Am. from British Columbia and Louisiana, as well as several of the original Texas specimens from Dr. Ravenel.

NUMMULARIA EXUTANS, CKE. l. c. Broadly effused, black, sub-cuticular, soon erumpent, thin (about one-half millimeter) papillose from the slightly prominent ostiola. "Two or three inches long, with an irregular outline, thinner than *N. rumpens*." Perithecia monostichous, depressed globose, less than one-half millimeter in diameter. In our specimen of this species from Dr. Ravenel, from his Texas collection, the asci had disappeared. The free sporidia were acutely elliptical or almond-shaped, rather variable in size, 10–15 by 6–8μ. Cooke says "ostiola depressed." In Ravenel's specimen they were as noted above; presenting the same

appearance as those of *N. rumpens*, from which this appears to differ in its more broadly effused, thinner stroma and depressed globose perithecia.

NUMMULARIA SUBAPICULATA, E. & E. (n. s.). On bark. Topeka, Kan. Cragin 267. Subcuticular, erumpent 1–2^{cm} across, convex, 1^{mm} thick or a little more in the center, with the sterile margin thinner. Ostiola slightly papillose, prominent as in the two preceding species. Perithecia monostichous, oblong, about three-fourths millimeter high, closely packed and more or less laterally compressed. Asci cylindrical, 90–100μ (p. sp.), with a short stipitate base, and with long stout paraphyses, as in *N. Bulliardi*. Sporidia uniseriate, oblong-navicular or inequilaterally-elliptical, pale yellowish brown, 12–16 by 5–7μ, mostly with a single nucleus and a faint, bead-like apiculus at each end. This was reported to Professor Cragin as *N. Bulliardi* Tul. It differs from that species as noted.

THE GENUS SCLERODERMA IN SACCARDO'S SYLLOGE.

By J. B. ELLIS.

This genus in Vol. VII, Part I, of the Sylloge appears to be made up of heterogeneous materials, being made to include not only the species usually known as *Scleroderma*, with a thick, corky peridium, but also species with papery-membranaceous peridium, heretofore included in *Bovista* and *Mycenastrum*. Among the latter we find *Mycenastrum Oregonense*, E. & E. This species was already sufficiently unfortunate in being overburdened with names, a comparison with authentic specimens showing it to be the same as *Bovista pila* B. & C., and *B. tabacina*, Sacc. It now becomes *Scleroderma Oregonense* and *Lanopila? tabacina!* The specific name *pila* being the one first given must take precedence, and unless the genus *Bovista* is to be abandoned I see no good reason why the generic name given by B. &. C. should not also remain. The species in question is closely allied to *Bovista nigrescens*, Pers. So closely in fact that, regarding only its external characters it could not safely be separated from that species. Its internal characters, however, are slightly different.

The true *B. nigrescens* (See English and Italian spec.) differs in its rather larger (5μ) spores, which are also often very slightly muriculate-roughened and have a hyaline pedicel about equal in length to the diameter of the spore, while in *B. pila* the spores are generally a little paler, not distinctly pedicellate and quite smooth. In both the capillitium is about the same, forming loose balls (2^{mm} diam.) closely packed and filling the entire peridium with a firm elastic purplish-brown mass. When examined microscopically this capillitium is seen to be made up of numerous small knots or ganglia consisting of intricately entangled

masses work of coarse, purplish-brown, branching threads 12 to 15μ. thick, which send out on all sides free, sub-dichotomously branched, sub-undulate arms tapering gradually nearly to a point and more or less distinctly granular-roughened or occasionally sub-tuberculose. *Mycenastrum corium*, Desv., of which, as shown by a comparison with authentic specimens *M. spinulosum*, Pk., is a synonym, has the capillitium of the same type only spinulose. This species is really only a *Bovista* with spinulose capillitium, and if the genus *Mycenastrum* is to be abandoned must fall into *Bovista* and not into *Scleroderma*, which differs in its thick, leathery peridium and different capillitium. If *Bovista pila* is to be placed in *Scleroderma* it is difficult to see why *B. nigrescens* and *B. plumbea* should not go there also. Nor is *Mycenastrum Ohiense*, E. & M., any more at home here, though it is not so easy to say just where it does properly belong, having, as it does, the sterile base of *Lycoperdon* with the capillitium of *Bovista*. I would leave *Bovista pila*, B. & C., where it is and make *Mycenastrum* a subgenus of *Bovista*, or if retained as a genus (which is perhaps preferable) restrict it to species with a spiny capillitium.

On page 53 of the volume cited we find another species to which several synonyms must be attached. (See S. Schulzer in Hedwigia, 1883, p. 43.) *Secotium Warnei*, Pk., *Columnaria*, Schulz., and *Secotium Thunii*. Schulz. are the same as *Secotium acuminatum* (Mont.) Tul.

This perhaps is not to be considered as a fault in the editor of the Sylloge, as this work aims only to give published descriptions; but without explanation one would suppose three distinct species where there is really but one.

Lycoperdon lepidophorum, E. & E., placed by Dr. De Toni in *Bovista*, we consider a good *Lycoperdon*, though not mentioned by Mr. Massee in his monograph of that genus. The deciduous scales correspond to the deciduous spines in some other species of *Lycoperdon* and are not to be considered as an outer peridium. The true peridium which is exposed when the outer scaly covering falls away is very thin and fragile and soon disappears.

SOME NEW SPECIES OF HYMENOMYCETOUS FUNGI.

By J. B. ELLIS and BENJ. M. EVERHART.

INOCYBE PALLIDIPES, E. & E. (N. A. F. 2102.) On the ground, under filbert trees, September and October, 1887 and 1888.

Pileus conic-campanulate, about 1^{cm} high, finally expanding and umbonate, 2 to 3^{cm} across, light brown, fibrose-squamose, margin subrimose, disk innate-squamose or subrimose squamose. Lamellæ broadly attached with a strong decurrent tooth, ascending at first, then ventricose, scarcely crowded, rather broad (3^{mm}), pale, becoming light watery cin-

namon or clay color, margins lighter, and under the microscope fringed with cylindrical, obtuse, hair-like bodies (abortive cystidia?) Stem $2\frac{1}{2}$–5^{cm} high, 2–4^{mm} thick, subattenuated and farinose above, white, solid, loosely fibrillose below, sub-bulbous and white tomentose at base, faintly annular marked above the middle when young, but this is hardly discernible in the mature plant. Spores brown, inequilaterally elliptical, 7–8 by 4–5μ. Basidia clavate cylindrical, about 22 by 8μ, with sporophores about $3\frac{1}{2}\mu$ long. Cystidia ventricose-fusoid or flask-shaped, 40–45 by 14–16μ. The disk of the pileus is carnose, and in wet weather rimose-squamose.

Well marked by its conic campanulate pileus and *white stem*, which remains white till the plant withers.

This and the other species of *Inocybe* here described were all found at Newfield, N. J.

INOCYBE MURINO-LILACINUS, E. & E. (N. A. F. 1905.) On bare ground under chestnut and filbert trees, September to October.

Pileus convex, 2–4^{cm} diameter, umbonate-discoid, silky-fibrillose, at length becoming squamulose around the margin, umbonate-discoid in the center, mouse-color, with a tinge of lilac when fresh and young. Stem 2 2–4^{cm} high, 2–4^{mm} thick, fistulose and soon hollow. Spores narrow-elliptical, with an oblique apiculus, rust-color, 7–9 by 4–5μ. Basidia 22–25 by 7μ, clavate cylindrical.

The broad, prominent disk of the pileus either has a small umbo in the center or a slight depression and is generally surrounded (about half-way to the margin) with a distinct ridge or zone. The margin also projects slightly and is a little lighter colored, and, under the lens, subfimbriate.

INOCYBE CICATRICATUS, E. & E. (N. A. F., 1901.) In gravelly sand near filbert trees, August–October.

Pileus broadly and obtusely conical or conic-campanulate, expanding to convex, 2–$2\frac{1}{2}^{cm}$ across, densely gray fibrillose-rimose, except the smooth (livid when moist) disk. Flesh white, compact in the disk, almost disappearing towards the margin, which is a mere membrane. Lamellæ, ascending, narrowly attached, with a slight decurrent tooth, becoming sub sinuate, dirty white at first, becoming dirty cinnamon brown, 3–4^{mm} wide. Stem stout, short ($1\frac{1}{2}$–3^{cm}), 2–4^{mm} thick, sub-bulbous at base, solid, nearly white, and covered with a short tomentose-pubescent coat at first, finally darker and smoother and very often eaten out by worms so as to appear hollow and then easily splitting. Spores very irregular in shape, mostly longer than broad, 7–9 by 5–6μ. Cystidia broad-fusoid, 50–55 by 12–15μ.

This comes near *A. umbonionotus*, Pk., in the 38th report, but the pileus is not umbonate nor are the spores nodulose, but simply angular (subquadrate), as represented in his *A. maritimoides*, which again is said to be "densely squamulose with small, erect or squamose-fibrillose scales."

The disk has something the appearance of a scar; hence the specific name.

INOCYBE ECHINOCARPUS, E. & E. (N. A. F., 1904.) On the ground in an old abandoned road among oak bushes, September–October.

Pileus conic-convex, not readily expanding, 1½–2^{cm} across, pilose-squamose, disk broken up into stouter scales similar to those of *Hydnum imbricatum*, color tawny yellow. Lamellæ subventricose, rounded behind and narrowly attached or nearly free, scarcely crowded, dirty-pallid, becoming clouded by the ferruginous spores, margins whitish and nearly entire. Stem 2½^{cm} long, 2–3^{mm} thick, solid, of fibrous texture, tough (bends short without breaking), farinose-floccose above, sub-attenuated and slightly silky-fibrillose below, a little darker than the pileus. Spores *echinate* (not simply angular or tuberculose), but thickly beset with short spines, irregularly globose or a little elongated, 8–11μ, diameter on subventricose basidia about 30 by 10μ, with stout, slightly spreading sporophores 4–5μ long.

This is a well-marked species, easily recognized by its echinate spores, broad basidia, and coarsely squamulose disk. There is no sterile projecting margin to the pileus, the ventricose gills coming out full to the margin. The measurement of the spores includes the length of the projecting spines and is mostly 8–10μ, exceptionally 11μ. This differs from *A. stellatosporus*, Pk., in its larger *echinate* spores and stem not scaly.

INOCYBE SUBDECURRENS, E. & E. (N. A. F., 1906). On the ground under the overhanging branches of Norway spruce, September–November.

Densely gregarious. Pileus 4–5^{cm} across, convex, expanding to plane, with disk depressed and either umbonate or not, but oftener without any umbo, surface densely and evenly appressed-pilose, color yellow-drab, flesh thin. Lamellæ moderately close, adnate-decurrent, pale dirty cinnamon, not changing much in color with age, about 3^{mm} wide, margins serrulate. In the mature plant the lamellæ are very slightly ventricose, but never depressed around the stem. Stem mostly straight, sub-equal, *hollow*, fibrillose-squamose above, covered with loose white silky fibres below and white tomentose at base, 3–4^{cm} high, ½–¾^{cm} thick, moderately tough. Spores elliptical, rounded at both ends, without any distinct apiculus, ferruginous cinnamon, 8–10 by 4–5μ on basidia, about 25 by 7–8μ. The stem is not simply fistulose, but in all mature specimens *hollow*.

This has been found in the same place in great abundance now for three years in succession.

INOCYBE TOMENTOSA, E. & E. (N. A. F., 2101). On the ground in grass, around and partly under the overhanging branches of Norway Spruces, at a short distance from the preceding species, but not mixed with it. July–September, 1888.

Gregarious and sub-cespitose. Pileus plano-convex, depressed in the center and generally with a small umbo, 2–4^{cm} across, margin at first

incurved and connected with the stem by a loose, dirty white, cottony web, surface *appressed strigose-tomentose*, light-drab color becoming yellowish. Stem 2–3^{cm} high, 2–3^{mm} thick, solid or at least with only a slight cavity above, indistinctly annular-marked above the middle, surface loosely fibrose cottony, white tomentose at base. Lamellæ attached with a slight decurrent tooth, finally slightly depressed around the stem, pale at first, then dirty cinnamon, 3–4^{mm} wide, hardly crowded, margins subserrulate. Spores elliptical, slightly inequilateral, 6–8 by 4μ, dark rust color, on clavate-cylindrical basidia about 27 by 7μ with erect sporophores 3–4μ long. The surface of the pileus can not be called striate, though the loosely matted hairs all radiate from the center. Smell not farinaceous, rather unpleasant.

I. subdecurrens is larger, with a *hollow* stem, and has the gills more crowded, nor is the margin incurved and tomentose, and it is also of a rather darker shade and has the margin of the gills more strongly serrate.

In *I. tomentosa* the margin remains incurved till the plant is nearly full grown. In *I. subdecurrens* the margin is never incurved even when young, nor is there any annular mark on the stem though the fibrous veil is at first distinct. There does not seem to be any doubt that the two species are distinct, though their general appearance is much the same.

AGARICUS (HYPHOLOMA) OLIVÆSPORUS, E. & E. (N. A. F. 2009.) Among moss in swamps. Newfield, N. J., July, 1888.

Pileus 1½–2^{cm} across, convex, subumbonate, dark brick color when moist, lighter when dry, covered with a dense furfuraceous or mealy coat which soon disappears. Lamellæ free, rounded behind, nearly plane, unequal, chestnut-brown (at first purplish-violet or purplish-brown), becoming lighter when dry and more or less tinged with brick-red. Stem slender, 3–4^{cm} high, 1½–2^{mm} thick, more or less curved or bent, about the same color as the pileus, and like it furfuraceous at first, of fibrous texture, fistulose, the cavity loosely filled, rather brittle. Spores when fresh olive-brown, the green shade very distinct, elliptical, 3½–4 by 2μ. Basidia clavate, with the apex rounded, 15–20 by 6μ. Spores becoming umber-brown in drying. There is no sign of any annulus on the stem.

The pileus when young is sometimes brick color, but soon becomes grayish-buff, except the umbonate disk, which retains more or less of the reddish tint. The loose mealy covering of the pileus is very distinct and does not entirely disappear in the mature plant. The margin of the pileus is not involute, hardly incurved, and is at first connected with the stipe by a loose webby veil, which remains hanging to the margin as the pileus expands. The plant is sometimes sub-cespitose and often grows from pieces of wood buried in the soil.

Resembles *A. microsporus*, Ell., in general appearance, but that has *white spores* and the stem strigose below and rooting.

MUCRONOPORUS E. & E.

A NEW GENUS OF POPOLYPOREÆ.

In examining some specimens of *Polyporus* in our herbarium we find several species having the inner surface of the pores studded with reddish-brown spines exactly as in the hymenium of *Hymenochæte.* The only described species having this character, so far as we know, is *Polystictus balansæ*, Speg., of which Saccardo (in Syll.) remarks that it might well be the type of a new genus ("facile novum genus"). And in fact it is just as reasonable to separate the spiny-pores species under a new generic name as to separate *Hymenochæte* from *Stereum.* We therefore here propose to separate these species, which are mostly of the genus *Polystictus*, under the generic name of *Mucronoporus* (Mucro and porus.)

MUCRONOPORUS CIRCINATUS, (Fr.). Fine specimens of this species were found some years ago at Newfield, N. J., among the decaying roots of an old cedar stump. Spines abundant, more or less curved, 60–75 by 8–10μ.

MUCRONOPORUS DUALIS, (Pk.) (specimen from Peck.) has the same hooked spines as the preceding, and is probably a form of that species.

MUCRONOPORUS TOMENTOSUS, (Fr.). Specimens collected by Dr. J. Macoun on Prince Edward Island. Spines very distinct, ovate lanceolate at first, finally more slender 35–70 by 12–20μ.

On account of the spiny hymenium we at first supposed this to be a new species, but authentic specimens of *Pol. tomentosus* from Finland (ex Herb. Karsten) have the hymenium of the same character, and there can be no doubt that the Prince Edward Island specimens are that species. A drawing has been made of one of these specimens, and we add a brief description.

Centrally stipitate. Pileus orbicular, 6–12^{cm} across, thin, strongly depressed in the center, light dirty yellow, innate tomentose, mostly zoneless, but sometimes indistinctly zonate, margin paler. Flesh of pileus light yellow, of fibrous texture about 2^{mm} thick, subcoriaceous. Pores of medium size, about 2^{mm} deep, round or sub-angular, some of them compound, *i. e.*, divided below by partial dissepiments, margins thin, whitish, and sub-lacerate, umber color within. Stipe 1–3 by $\frac{1}{2}$–1^{cm} spongy, cinnamon color, minutely tomentose. The general appearance is that of *P. perennis*, but the pileus is of a brighter yellow and more distinctly tomentose, and the inner surface of the pores is studded with reddish brown ovate conical bodies 35–75 by 12–30μ, apparently of the same character as the bristles in *Hymenochæte*, only stouter. Plate VIII, figs. 1 and 2, show the upper and lower surface of the pileus. Fig. 3, section of pores, showing the projecting points or spines. Fig. 4, one of these spines magnified. Fig. 5, spine with a bifid tip.

MUCRONOPORUS GILVUS, (SCHW.). In all the specimens of this species the spines are present but not abundant. They project 15-20μ and are about 4–5μ thick at the base.

MUCRONOPORUS ISIDIOIDES, (BERK.). The specimens of this species in de Thümen's **Mycotheca** 1105, from South Africa, as well as those from Ohio (ex herb. Berk.), have spines of the same appearance as in the specimens of *P. gilvus*, and this is another indication that this so-called species is only a form of *P. gilvus*.

MUCRONOPORUS SETIPORUS, (BERK.). (Specimens from Ceylon, com. Cooke.)

Spines 25–30 by 4μ.

MUCRONOPORUS LICNOIDES, (MONT.). (Specimens from Brazil, com. Cooke.)

Spines abundant, rather short, 15-20μ.

MUCRONOPORUS CICHORIACEUS, (BERK.). (From Australia, com. Cooke.)

Spines quite abundant, projecting 25–35μ long, and about 5μ thick at the base.

MUCRONOPORUS TABACINUS, (MONT.). (From New Zealand, com. Cooke.)

Spines more abundant than in the specimens collected by Dr. Martin in Florida and distributed in N. A. F. 1705.

MUCRONOPORUS SPONGIA, (FR.). (Specimen from Cooke.)

Spines 20–25 by 6–8μ, curved like the spines on a rose bush.

MUCRONOPORUS CROCATUS, (FR.). (Specimens in Rav. F. Am. 707 and 708.)

Spines 25–30 by 4–5μ.

MUCRONOPORUS BALANSÆ, (SPEG.).

Fungi Guaranitici Pugill. I. No. 42. Spines 20–25 by 5–6μ.

In the measurement of the spines we have given the length of the projecting part. The base of the spines penetrates more or less deeply into the hymenial layer of the pores, and if this is included the length will be somewhat greater.

TRIBLIDIUM RUFULUM (SPRENZEL).

By J. B. ELLIS.

This appears to be a variable species. The specimens in Rav. Fungi Car. Exsicc. II, No. 47, have the sporidia oblong, slightly curved, nearly opaque, 3-septate, 24–30 by 10–12μ, very slightly or not at all constricted at the septa. Specimens found by Mr. Langlois (No. 130) on dead fig tree in Plaquemines Parish, La., agree with Ravenel's Carolina specimens, unless in having the sporidia a little more constricted. In the specimens from both these localities the hymenium is of a deep *brick-red* color and the lips are slightly transversely striate. Specimens collected at Ocean Springs, Miss., in February, 1887, by Mr. F. S. Earle (No. 202), agree with the Carolina and Louisiana specimens in all respects except in having the sporidia only 1-septate and a little smaller

(18–22 by 8–10μ). We have designated this as var. *simplex*, E. & E. Specimens found by Col. W. W. Calkins near Jacksonville, Fla., January, 1889, have the 3-septate (24–30 by 10–12μ) sporidia of the Carolina and Louisiana specimens, but the hymenium is *slate* color, the perithecia cespitose (they are scattered in all the others), and the lips very distinctly striate. We have called this var. *fuscum*, E. & E.

BRIEF NOTES ON A FEW COMMON FUNGI OF MONTANA.

By W. F. Anderson.

Claviceps purpurea, said to be comparatively rare in many Eastern States, is found everywhere in the Territory. I have found it on four species of *Elymus*, on three species of *Poa*, on six species of *Agropyrum* as well as on *Kœleria cristata*, *Phalaris arundinacea*, and several other grasses. The little rye grown is not materially injured by the *Claviceps*. I have collected this fungus at 8,000 feet altitude; it is as common at that height as at 3,000 feet—the general average of Montana's plains above sea level.

Some years the loss to stock-men from the abortions of cows and mares is heavy. Many claim that losses from this cause are greater in seasons when an unusual abundance of ergot is developed on the grasses; but there are others who scout this idea. However, whether the eating of ergot in considerable quantity by stock has an irritating influence on the internal genitals or no, it is certain that the general health of the animals is impaired thereby.

Ustilago caricis is remarkably plentiful, pretty regularly every other year. Whether it is a baneful fungus to the health of stock I am not prepared to say. It is at any rate seriously injurious to three small but important forage plants, viz: *Carex filifolia*, *Carex stenophylla*, and *Carex Douglasii*. These sedges, especially the first, comprise a considerable proportion of the "grass" on the plains, and are eagerly eaten by stock. In April they are in flower and by the 1st of May their fruit is more or less fully developed. Diseased spikes are very conspicuous in the immature stage of the fungus by the round lead-colored balls attached to them. Later this lead-colored coat breaks, and the intensely black spores are seen to cover the balls. Stock avoid plants in this condition.

Ustilago segetum as yet is not seriously injurious to cultivated cereals. It is rather common, however, on the weed *Hordeum jubatum*.

Ustilago minima is common on *Stipa comata*. It destroys the panicle almost entirely. In autumn the bare blackened rachis breaks out of the sheath and curves outward and downward, almost touching the ground.

Another *Ustilago* which bids fair to do considerable damage to *Muhlenbergia* as soon as that grass is cultivated as a regular crop is the new

Ustilago Montaniensis Ellis & Holway, on *Muhlenbergia glomerata* var. *setiformis*, first discovered by the writer December 12, 1887. This appears to be one of the most destructive species of *Ustilago* we have. The host plant begins to "head out" when it is 3 inches high. These early panicles are lateral, and smaller than the final terminal panicle, which, under favorable conditions, is developed by the time the plant is 24 or 30 inches high. Culms affected by the fungus are generally stunted and thickened, becoming harsh and knotty. Their panicles are usually aborted from first to last. Sometimes only the lower or middle spikelets in the dense spikes are infected, the rest being perfect and producing seed. In the case of the small lateral panicles, which are mostly smutted entirely, the panicles do not grow out of the sheaths, but are inclosed by the united and membranous bases of the sheathing leaves. As the fungus develops this usually cylindrical or oblong sac enlarges and gradually loses its leaf character, except where its two parts extend above and beyond the inclosed panicle. The membrane surrounding the smut has by this time become a leaden-gray color, and exceedingly thin and chartaceous. Where only more or less isolated small spikes and spikelets of a panicle are affected, the surrounding membrane is formed by the uniting of the glumes, which are free and maintain their true character only at their tips.

Three times out of five if the fungus is present it affects all the panicles. When the very first one appears in an infected plant it will be found full of smut, and each succeeding panicle as it is developed will be found to be in a similar condition, so that it is evident the fungus develops with the host. The host is a perennial, and so far as I have been able to discover by examining old and new culms, representing four years' growth, the plant once attacked is affected each succeeding year until its death. As *Muhlenbergia* is a valuable grass and will soon be common in cultivation, this fungus ought to receive careful attention.

ERYSIPHE GRAMINIS is a common pest in some sections, notably in southern Montana, west of the main divide of the Rocky Mountains. It affects chiefly the *Poas* and is especially damaging to *Poa tenuifolia*, one of our most valued forage grasses. The asci of the fungus contain ripe spores in November.

PUCCINIA RUBIGO-VERA is common everywhere. I have collected it on fourteen species of native grasses. It is most damaging to *Elymus condensatus*. Wheat and oats do not suffer from it as yet.

PUCCINIA TANACETI occurs on many hosts. The cultivated Sunflower is sometimes ruined by this fungus. The common Sage-brush (*Artemisia tridentata*) is frequently attacked so overwhelmingly by *Puccinia tanaceti* that its flowers dry up and its leaves fall off. The fungus attacks the younger stems and shoots, blackening them also. I have found it on five species of *Artemisia*, viz: *A. tridentata*, *A. cana*, *A. Ludoviciana*, *A. frigida*, and *A. dracunculoides*. On *A. dracunculoides* and *A. Ludoviciana* I have found one of the numerous *Æcidium com-*

positarum forms occurring with the uredo of *Puccinia tanaceti*, closely followed by the teleutospores. The same *Æcidium* occurs on all five, and is invariably followed, if not accompanied, by the uredo and teleutospores of this fungus.

PHRAGMIDIUM SUBCORTICIUM occurs, sometimes to an alarming extent, on *Rosa Arkansana*, *Rosa blanda* (?), and *Rosa Sayi*. No doubt it would do serious damage to cultivated roses in certain localities. At Helena in 1887 I found several cultivated varieties more or less affected by the *æcidium* of this fungus. On the wild roses the uredo and teleutospores do serious injury, some years destroying the leaves.

MELAMPSORA SALICIS is found on nearly all our Willows. I have found it abundantly on *Salix longifolia*, *S. cordata*, *S. amygdaloides*, *S. rostrata*, *S. flavescens*, and *S. glauca*. It appears to be most injurious to *Salix cordata* and *Salix flavescens*. Sometimes in the early fall great clouds of the red uredospores are blown from the trees, sprinkling the vegetation for some distance around. Last year this *Melampsora* was unusually prevalent and vigorous in its attacks. I found it both sides of the main divide of the Rocky Mountains, from the southern border of the Territory and the source of Clarke's Fork of the Columbia River and the source of the Missouri River, thence northeastward to within fifty miles of the Canadian line. Good sized trees in some localities were almost entirely defoliated. On the banks of the Upper Missouri, in one locality, were found in September several hundred acres of seedlings of *Salix amygdaloides* and *Salix cordata*, then from 3 to 6 inches high and as close as grass, which were probably permanently ruined by the uredo of *Melampsora salicis*. The leaves, especially the lower ones, had all fallen from the effect of the parasite and were decaying. The upper leaves were almost devoid of chlorophyll and evidently perishing.

MELAMPSORA POPULINA, like the last, was very abundant last year and did considerable damage to *Populus tremuloides* and *P. angustifolia*. I also found it on *P. monilifera*, *P. balsamifera*, and *P. angulata* more sparingly.

MELAMPSORA LINI some seasons is ruinous to *Linum rigidum*, and also sharply attacks *Linum Lewisii* (commonly called *L. perenne* by western collectors). *Linum Lewisii* is rather similar to the cultivated flax, and if the latter were introduced it would doubtless suffer more or less from this fungus.

SPOTTING OF PEACHES.

By ERWIN F. SMITH.

A recent paper on this subject by Dr. J. C. Arthur (Bull. Agr. Exp. Sta., Indiana, No. 19, 1889) leads to the following remarks:

Cladosporium carpophilum, v. Thümen is undoubtedly the conidial stage of some well-known ascomycetous fungus. It occurs on the leaves

as well as the fruit, and I think also on the branches. It is by no means confined to Indiana, or rare in any peach district in the United States. It is common along the Atlantic, in the region of the Great Lakes, in the Lower Mississippi Valley, and in California. In Maryland and Delaware it has been known for many years, and is so abundant that its presence is regarded as a matter of course. The choice early peaches and the middle varieties are little subject to it, but Smocks and nearly all late and inferior sorts are more or less spotted. So constant is this spotting that many peach-growers have come to consider it as *characteristic* of certain varieties and have no idea that it is abnormal.

It injures the appearance of the fruit somewhat, and when very abundant the flavor also, unless I have been much deceived. Growers do not generally regard it as a serious evil, or indeed as a matter of any consequence. The loss in late sorts with firm flesh is nevertheless sometimes very considerable. So far as my own observation goes this results principally from cracking and rot, in much the same way as in apples and pears when badly attacked by *Fusicladium*. The half-grown peach forms a protective layer of cork beneath the most thickly spotted surface. This cork layer is incapable of further growth and is ruptured in deep irregular fissures when the peach rapidly enlarges during the last few days of its growth. The spores of *Monilia fructigena* Pers. fall upon this exposed surface and rot begins immediately. The cracking appears to be worse in rainy weather, which is also the most favorable condition for the rapid development of the rot. In September, 1888, in the great peach region of Maryland and Delaware (the north part of the peninsula) fully one-half of the Smock peaches, aggregating many thousand baskets, were lost by rot during a rainy week. Cracking of the fruit often preceded this rot and was due in part to *Cladosporium*. Nevertheless the loss would have been inconsiderable but for the presence of this other much worse parasite—the rot fungus.

In 1886 and 1887, two very rainy seasons *Cladosporium carpophilum* was abundant in Maryland and Delaware, and I am therefore inclined to think that dry seasons are not specially favorable to its growth.

EXPERIMENTS IN THE TREATMENT OF GOOSEBERRY MILDEW AND APPLE SCAB.

Prof. E. S. Goff, of the New York Experiment Station, has kindly furnished us with the results of his experiments in the treatment of these diseases in 1888, which we give in full below:

POTASSIUM SULPHIDE FOR THE GOOSEBERRY MILDEW.

At the suggestion of Dr. J. C. Arthur,* formerly botanist to the

* For results secured with this substance by Dr. Arthur in 1887, see Report New York Agricultural Experiment Station, 1887, pp. 248–252.

station, a series of trials was made with potassium sulphide (liver of sulphur) as a preventive of injury from the disease of the gooseberry plant commonly known as "mildew," and due to a fungus parasite known to science as *Sphærotheca mors-uvæ* B. & C. The substance was applied in solution at the rate of one-half and one-fourth ounce to the gallon, respectively, commencing May 3, or as soon as the leaves had begun to expand, and the application was repeated after every hard rain until June 24, nine sprayings having been made in all. The experiment was made upon a row of the Industry gooseberry containing five plants, and upon a plat of seedlings numbering 282 plants.

Toward midsummer the effect of the spraying became distinctly visible in the deeper green foliage and more rapid growth of the treated plants. On June 23 the two plants of the Industry gooseberry that received the sprayings were noted as being entirely free from mildew, with the exception of a trace of it observed on a single fruit, while the three not treated were quite badly affected. The fungus appeared as a downy coating near the ends of the new shoots, and also upon the berries. The new growth, as well as the crop of fruit, was very perceptibly greater on the treated plants. At this time the bed of seedlings had not been perceptibly attacked by the fungus.

On July 16, the seedling plants were found to be considerably affected, and an examination showed that in the row treated with the sulphide at the rate of half an ounce to the gallon, only one plant exhibited signs of mildew out of a total of 60—about 1.7 per cent; in the row treated at the rate of one-fourth ounce to the gallon 3 plants were affected out of 43—about 7 per cent.; while in 133 plants not treated, 15 were affected, or about 11.3 per cent.

As these plants were all seedlings from native varieties and are not all subject to mildew, these figures are only an indication of the effects of the treatment and not a proof, for I do not know how many plants in the treated rows would have been affected had the applications not been made. There could be no question, however, as to the benefits resulting from the treatment. As far as the plantation could be seen the sprayed rows were conspicuous for the richer green of their foliage; and the row receiving the stronger solution showed somewhat greater vigor than the other. A part of this benefit, however, probably resulted from the influence of the sulphide in destroying or repelling the currant worm, as the treated plants were noticeably less injured by this insect than the others. A part also may have resulted from the fertilizing effect of the potash applied.

In the latter part of summer, after the spraying had been discontinued, the mildew increased on the treated plants, showing clearly that the applications were beneficial, and also that they must be continued throughout the growing season to confer their greatest benefit.

SODA HYPOSULPHITE CONTRASTED WITH POTASSIUM SULPHIDE AND CALCIUM SULPHIDE FOR THE APPLE SCAB.

In former reports are given the results of experiments with soda hyposulphite for the apple scab, *Fusicladium dendriticum*, Fckl. From these it appears conclusively that this substance as used acted beneficially, but that it was not a complete remedy for this disease. It is very desirable that some substance be found that will prove more effectual in destroying this fungus without causing greater harm to the foliage. Two other compounds of sulphur, viz, potassium sulphide and calcium sulphide, were therefore tested the past season. The first trial was made with the potassium sulphide in solution, at the rate of half an ounce to the gallon, upon the crab-apple tree treated for three seasons preceding with soda hyposulphite, as described in the experiments cited.

The spraying, which was done with the so-called Little Gem force-pump, fitted with a "Climax" nozzle, was made upon the west half of the tree only, and was commenced May 10, just as the leaves were expanding, and repeated after every hard rain until July 24, eight applications having been made in all.

The tree blossomed alike, apparently, on both the sprayed and unsprayed portions, but the crop of fruit matured was much larger on the sprayed part, and, as the following figures will show, was of much better quality.

On September 12 a quantity of fruit was picked from the sprayed and from the unsprayed parts of the tree, and each lot assorted into three classes, in order to determine their relative injury from the disease. In the first quality were put only fruits nearly or quite free from scab; in the second those that were considerably scabby, but not so much as to distort their form or prevent them from acquiring their normal size, and in the third those which were distorted in form or diminished in size by the growth of the fungus.* The results secured as follows:

	Number of fruits examined.	Per cent. in first quality.	Per cent. in second quality.	Per cent. in third quality.
Sprayed part	1,560	75.9	22.6	1.5
Unsprayed part	627	46.9	45.3	7.8

More than 627 fruits did not mature on the unsprayed part of the tree. On the sprayed part, however, many more might have been gath-

* This classification is necessarily somewhat arbitrary, but, as the assorting was done with care, it is believed that the figures represent the true proportions of the amount of injury wrought by the scab. Almost all the fruits were somewhat scabby in the cavity about the stem, but if not affected elsewhere, this did not exclude them from the first quality.

ered. If we ascribe the larger crop on the sprayed part to the influence of the application, it is evident that the figures express but a small part of the benefit resulting from the treatment. Aside from the difference in crop, the fruits on the unsprayed portion were inferior in size to those on the other part.

A comparison of the results secured the past season with potassium sulphide with those secured on the same tree in 1885 and 1887 with soda hyposulphite would indicate that the former proved the more effectual. Such a comparison, however, may not be just.

In a second trial, ten trees of the Fall Pippin apple were treated as above described, with solutions of three compounds of sulphur, viz: Soda hyposulphite, at the rate of half an ounce to 10 gallons; potassium sulphide, half an ounce to the gallon; and calcium sulphide in a saturated solution, the spraying in every case being made on the same day and in the same manner. The trees were divided into three series, the second, fifth, and ninth forming the second, and the third, sixth, and tenth the third series. The first sprayings were given June 5, by which time the leaves were well expanded. Other sprayings were made June 16, June 27, and July 2, each of which shortly succeeded a hard rain.

On September 21 the fruits on the sprayed and unsprayed portions of each of the ten trees were picked, with the exception of a belt about 3 feet wide across the center of the trees where the sprayed and unsprayed parts were supposed to meet. The apples were then assorted into three qualities, as described in the case of the crab apple tree, with the following results:

	Number of fruits examined.	Per cent. in first quality.	Per cent. in second quality.	Per cent. in third quality.
First series—Soda hyposulphite:				
Sprayed part	495	56.56	27.91	16.43
Unsprayed part	397	46.85	27.96	25.19
Per cent. in favor of sprayed part	....	9.71	....	8.76
Second series—Potassium sulphide:				
Sprayed part	960	31.35	40.11	28.54
Unsprayed part	247	22.67	36.03	41.30
Per cent. in favor of sprayed part	....	8.68	....	12.76
Third series—Calcium sulphide:				
Sprayed part	315	28.26	40.95	30.79
Unsprayed part	129	37.21	33.33	29.46
Per cent. in favor of unsprayed part	....	8.95	....	.67

From this trial it does not appear that the potassium sulphide was decidedly more effectual than the soda hyposulphite, although as applied it contained about fifteen times as much sulphur. The soda hyposulphite injured the foliage somewhat, and evidently could not be safely used in a stronger solution.

The calcium sulphide apparently did no good whatever. This substance is only very sparingly soluble in cold water, which may account

for its inaction. The fact that the sprayed part, when treated with this substance, showed so much greater percentage of injury than the unsprayed throws a possible doubt over the whole trial, for we can not suppose that this compound of sulphur could have favored the growth of the fungus.

The results of these tests appear to warrant the following conclusions:

First. That soda hyposulphite and potassium sulphide, as applied, proved beneficial in preventing injury from the fungus. This conclusion is strengthened by the results secured in previous experiments already cited.

Second. The tests do not prove that the greater amount of sulphur added in the potassium sulphide as compared with the soda hyposulphite rendered this substance the more effectual, though there are indications in this direction.

Third. That calcium sulphide is of little or no value for the purpose used.

Fourth. That while further experiments are needed to furnish data from which we may compute the actual benefits conferred by the treatments, the indications are that the good accomplished was sufficient to warrant the slight cost of the materials in the case of orchardists who spray their trees for the codling moth.

NOTES.

By B. T. Galloway.

SULPHURET OF POTASSIUM FOR BITTER ROT OF THE APPLE.

Judging from the reports received bitter-rot of apples (*Glœosporium fructigenum*) is on the increase. Last year (1888) Mr. J. W. Beach, of Batavia, Ark., made some experiments with the view of finding a remedy for this disease which are not without interest. We wrote Mr. Beach early in March, 1888, requesting him to spray the fruit five or six times during the season with a solution of sulphuret of potassium, one-half an ounce of the potassium to the gallon of water. In accordance with our instructions the first application was made when the apples were about one inch in diameter, and the Lewis Combination Force Pump was used for the purpose. The second application was made three weeks later, and was followed by a third in about a month. Up to the time of the third application very little rot had appeared on the sprayed apples, while those not sprayed rotted badly. Unfortunately at this time the supply of the fungicide became exhausted and nearly two months elapsed before enough was obtained to make the fourth application. During this interval much of the sprayed fruit which had hitherto remained healthy fell a prey to the disease, and, in spite of all treatment, this continued until the fruit was harvested. Mr. Beach, however, has full confidence in the remedy and says that during the

coming season "every precaution will be taken to apply it in *advance of the fungus.*"

This last statement is the key to success in the treatment of all fungous parasites. The treatments must be made before infection has taken place.

BORDEAUX MIXTURE FOR THE PLUM LEAF-BLIGHT.

In many parts of the South and West peach and plum trees suffer from the attacks of a parasitic fungus (*Puccinia pruni-spinosa*) belonging to the rust family. This fungus attacks the leaves, causing them to fall long before the proper season. During the summer and autumn of 1888 Prof. T. L. Brunk, at our suggestion, conducted a series of experiments at the Texas Agricultural College with the view of finding a remedy for this pest. Professor Brunk writes as follows concerning the results of his experiments:

I am greatly encouraged by our experiments with the Bordeaux mixture sprayed upon two rows of trees August 21 last. Two rows which alternated with three others that were carefully and thoroughly pruned last winter were selected for the spraying. On October 5 the plants were examined and it was found that those not treated had lost nearly all of their foliage, while those sprayed had lost only a very small per cent.

Professor Brunk concludes as follows:

At this writing (October 30) the difference in the treated and untreated trees is very marked. Those that were sprayed have yet about two-fifths of their leaves, while the alternating check-rows are nearly leafless. We intend to begin in the spring next year, and I believe that if the trees are sprayed about three times during the growing season—the first when the fruit is setting, the second about a month later, and the third in August, or after the fruit is picked—that the fungus will cause little injury.

A TOMATO DISEASE.

Of late years Mr. Marcius Wilson, of Vineland, N. J., has had considerable trouble with a fungus which attacks his tomatoes, especially those grown under glass. It appears on the leaves and young shoots at any time during the winter, and often kills them outright or greatly injures their vitality. From specimens communicated by Mr. Wilson it was learned that the disease was caused by *Cladosporium fulvum*, a fungus which has occasioned considerable injury in England.

According to Col. A. W. Pearson, Mr. Wilson has succeeded this year in completely holding this fungus in check by the use of the Bordeaux mixture, containing 6 pounds of copper and 4 pounds of lime to 22 gallons of water. The first application was made in December, while the plants were yet apparently healthy. For applying the remedy the Eureka Sprayer was used, and it answered the purpose "admirably."

REVIEWS OF RECENT LITERATURE.

WORONIN, Dr. M. *Ueber die Sclerotienkrankheit der Vaccinen-Beeren.* Entwickelungsgeschichte der diese Krankheit verursachenden Sclerotinien, mit 10 Tafeln. Mémoires de l'Académie impériale des Sciences de St. Pétersbourg, VII. Sér., Tome XXXVI, No. 6., Prix: 6 m.

The *Sclerotium diseases of Vaccinium berries* is the title of a new German work by Dr. M. Woronin, which forms one of the memoirs of the Royal Academy of Sciences of St. Petersburg.

Four species of *Sclerotinia*, each attacking a different species of Vaccinium are described and illstrated. The species and hosts are (1) *Sclerotinia vaccinii*, Wor. on *V. Vitis Idæa;* (2) *S. oxycocci*, Wor. on *V. oxycoccus;* (3) *S. baccarum*, Schr. on *V. myrtillus;* and (4) *S. megalospora*, Wor. on *V. uliginosum.*

The first named species is described in detail, and the following abstract consists mainly of the author's own summary.

Sclerotium vaccinii is a true parasite, which, however, leaves its host when the Sclerotium is mature, in order to develop itself farther at the expense of the reserve material which it has already appropriated.

The gonidial stage appears in the spring upon leaves and stems of the new shoots of the Cowberry, in the form of a dense, powdery, mold-like coating which emits a strong, pleasant, almond odor. On the stem the fungus usually appears near the end and only on one side, causing the branch to bend so that the fungus comes on the under concave side. The disease proceeds from the stem into the leaves, the bases of which become discolored. In the stem the greatest injury is caused to the cambium layer, which shrivels up and separates from the wood. In the outer bark tissues between the decaying cells is formed a pseudo-parenchymatic cushion from which simple or often dichotomously branched hyphæ break out through the cuticle. These hyphæ are at first beaded and continuous, but later double septa appear at the constrictions. In the center of these septa is cut out a spindle-shaped piece of cellulose, the "disjunctor," which serves the purpose of separating the gonidia at maturity. The ends of the gonidia are at first incurved around these pieces, but when they separate the ends push out, making the gonidia lemon-shaped. The septa form parts of what the author calls the "primary membrane" of the spores, which forms just within the common cell-wall of the original beaded hypha.

The ripe, separated gonidia germinate very differently according to the medium in which they happen to be placed. In perfectly pure water the surface of the gonidium becomes covered with small, round spermatia-like sporidia, which are incapable of germination. In slightly impure water the gonidia put out short hyphæ, which in turn produce

and cut off these small bodies on all sides. In fresh juice pressed from a ripe plum the gonidia grow into branched, many-celled germ tubes, whose cells at once swell up into large spheres and easily anastomose. Finally, in plum and raisin decoction the gonidia produce long, separate, often anastomosing branched hyphæ, which when transferred into pure water again produce the globose sporidia, although they do not do so in the other media.

These gonidia are carried by the wind to the stigmas of the *Vaccinium* flowers, where they germinate. The germ tubes follow the path of the pollen tube, grow down into the ovary, and there develop into a sclerotium-forming mycelium. The cells of the ovary first become filled with a sclerotium-like mass, and the ends of the hyphæ form a palisade-like layer against the ovary wall. Later branches of the hyphæ break through into this wall and form a sclerotium there also. In the mean time some of the central portion has disappeared, so that the complete mature sclerotium is hollow and is composed of two layers, the inner one consisting of the palisade portion of the mass within the ovary cells, and the outer of the pericarp permeated by the fungous mass.

A sclerotium finally develops in every infected berry. Instead of ripening,the berries become dark colored, fall from the plant at the end of the summer, and remain under the snow without any noticeable change through the winter.

In the spring, just after the melting of the snow, primordia are produced somewhat below the rind of the outer layer. These do not always develop farther, more than one of them growing out into chestnut-brown, long-pedicelled, cup fruits only in occasional instances.

The apothecia are bell-shaped at first, later they are plate-like, and finally the edge sometimes turns downward. When the cup is fully formed a shaggy tuft of rhizoids grow out from the base of the stem; they serve the plant not only as a support but as an organ for obtaining nourishment.

The hymenium is composed of paraphyses and asci, the latter being formed from the primordia themselves and the former from outgrowths of the cells of the outer layer of the sclerotium. The paraphyses are fine, simple or dichotomously branched, septate hyphæ, whose upper free ends are slightly club-shaped and surrounded by a brown balsam-like mass. The asci always contain eight ascospores of nearly uniform size, all capable of germination.

Like the gonidia, the ascospores germinate differently according to the substratum in which they are sown. In pure water they also cut off small, globose, spermatia-like sporidia from their sides. In a plum decoction they grow out into long, irregularly formed threads, and swollen spherical protuberances. In a decoction of fresh leaves and young stems of the Cowberry the ascospores put out one or several fine germ tubes, between which and the globose sporidia almost all the intermediate stages can be found.

The ascospores infect the unfolding shoots of the Cowberry in the spring, about the end of May or beginning of June. At the point of contact with the host plant an ascospore puts out one, occasionally two, slender germ tubes, which never penetrate through a stoma but bore between two adjacent epidermal cells or directly through one of these into the host plant.

The germ tubes which are produced by the ascospores seek the fibro vascular bundles of the host plant, and continue their growth from these bundles as a centre, thus reversing the direction of the fungus so that it grows from the center of the plant toward the periphery. Then appears a most peculiar phenomenon; the fungus exerts an injurious influence on the surrounding tissues of the host plant, killing them first and then using them as food for its further development.

Finally the hyphæ penetrate between the elements of the outer rind, which has been killed by the fungus, and there develop into a large-celled, pseudo-parenchymatic, stroma-like cushion, from which the gonidia chains grow into the air through the ruptured cuticle.

The other three species are dealt with much more briefly, since their general characteristics are much the same as the first one. In the chapters devoted to them the author deals mainly with the features which distinguish them as distinct species and wherein they differ from the first.

He suggests that the second species which attacks the small cranberry, *Vaccinium oxycoccus*, may be the same one that attacks the American cranberry, *V. macrocarpon*, and if this is true says that the matter of routing the disease is an easy one, viz, collecting and burning all the diseased berries in the fall. To one acquainted with the manner and places of growth of American cranberry vines this method might present some practical difficulties.

In conclusion there are a few notes on other forms.

He found the gonidia and a sclerotium like condition of *Acrosporium cerasi*, Rabh., which occurs on the cherry. On *Prunus padus* he found a fungus having the three forms, gonidia, sclerotia, and apothecia, and analogous forms were observed on *Sorbus acuparia*. He is also of the opinion that the well-known *Monilia fructigena* is only the gonidial form of a similar Sclerotium. He has found Sclerotia in the fruit of *Alnus* and *Betula*, and in the latter case has seen a cup fruit grow from the Sclerotia in the spring.

The work is a valuable contribution to our knowledge of the life histories of the *Sclerotiniæ*, and the author's name is sufficient authority for its perfect reliability. The illustrations are particularly fine, and it is a deplorable fact that very few American works can point to similar ones.—EFFIE A. SOUTHWORTH.

JENSEN, J. L. Journal of the Royal Agricultural Society of England, Vol. XXIV., Part II. *The propagation and prevention of smut in oats and barley.*

This is the title of a paper which has been reprinted in pamphlet form from the journal of the Royal Agricultural Society of England. The paper is full of practical ideas, many of which are comparatively new, and deserves careful attention by all grain-growers.

The paper is divided into three parts: A. Propagation of smut; B. Varieties of smut; C. Prevention of smut. Under the first head Mr. Jensen states (1) The spores of smut falling on the ground during the summer will not to any appreciable degree affect barley and oats grown in that field in the ensuing season. (2) The spores of smut in farm-yard manure, when applied to the field, will not to any appreciable extent affect oats and barley. (3) Spores of smut adhering externally to the seed of barley and oats are unable, to any appreciable degree, to infect the crop produced from that seed. (4) Although, as is shown by the foregoing, it is impossible to infect oats and barley with smut spores to any appreciable extent by applying them to the seed, yet there can be no doubt that the spores are the reproductive bodies of the fungus by which smut is propagated in nature.

The first three statements are supported by statistics of experiments in which seed was sown in soil containing smut spores, in heavily manured soil, and with spores dusted on the outside of the *seed; in no case was there an appreciable increase in the amount of smut.* Under 4, Mr. Jensen attempts to answer the question, "In what manner does the propagation of smut take place?" His experiments led him to the following solution of the question: Infection takes place by means of spores which, having gained admission within the husk, remain there quiescent until the grain germinates.

Under B is given the results of experiments to determine whether or not the smut which affects barley, oats, and wheat are the same species. The author concludes from these trials that if these smuts are not different species they are at least well marked varieties. He further remarks that to the farmer this information is of importance, as there is no fear of adjacent fields sown with different crops infecting one another; a smutted barley field, for instance, will not infect a field of oats, or *vice versa.*

C. *Prevention of smut.*—The various dressings, such as sulphate of copper in solution, solution of sulphate of copper with quicklime applied about twelve hours afterward, sulphuric acid and water, quicklime with or without subsequent treatment with common salt are first enumerated under this heading. The author then gives the results of his experiments with these preparations as well as with several methods of his own conception, which consisted in exposing the grain to dry and moist heat, also soaking it in water ranging in temperature from 123° to 133° Fahr.

Concerning the action of sulphate of copper (bluestone) Mr. Jensen says that one-fourth per cent. of this salt reduced the per cent. of smutted heads to such an extent that it might be considered practically sufficient. A part of the seed-crop was killed, however, and the crop suffered not inconsiderably. With a 1 per cent. solution about three-fourths of the seed was killed, and a large number of plants remained without rootlets for two or three weeks. This lot was still green when all the others were almost ripe. The remaining experiments demonstrated beyond question that the seed in many cases was destroyed or its vitality was greatly injured by dressing with the preparations enumerated above; they moreover showed that disinfection by heat was the safest and most satisfactory way of treating the grain. The author concludes his remarks on this subject as follows:

> Dressing cereals with sulphate of copper in the usual manner against smut and bunt causes, as a rule, a waste of seed. It is, moreover, injurious to the plants and is unnecessary. Treating the seed with water heated to a temperature of 127° Fahr. for five minutes prevents these diseases equally well and protects barley much better, while it has the advantage of not injuring the seed or the resulting crop.—B. T. GALLOWAY.

KELLERMAN, W. A. Experiment Station, Kansas State Agricultural College. Bulletin No. 5, Dec., 1888. *Preliminary Report on Sorghum Blight.*

The paper describes the appearance of the disease, and gives briefly the results of the laboratory experiments, which were performed by W. T. Swingle.

Plants were examined first with reference to the disease being caused by insects and the theory disproved.

The most common and evident appearance of the disease is in large blotches on the leaves. The roots were examined and found to be diseased also, often to such an extent as to be entirely destroyed, and in this case the stem at the junction of the roots was also diseased; in other cases the stem was intact, except where it had been wounded.

The microscopic examinations resulted in proving the disease to be the work of a micro-organism, the *Bacillus sorghi*, belonging to the group of *Bacteria*. The presence of the germ was demonstrated by the microscope, and the disease was produced on young and apparently healthy plants by inoculating them with a broth containing the organisms.

Sorghum seed was planted at the same time in soil taken from a field of diseased plants and in soil from the greenhouse. The plants which were produced in the former were all badly diseased, and those in the latter not at all or only slightly.

He concludes (1) that it is not wise to use a field in which the disease has been present even in a mild form the year before; (2) when the crop is infected, not even the stubble should be plowed under but collected and burned.

A list of varieties which are free from or subject to attack is also given. The paper is one of great practical value to sorghum growers.—EFFIE A. SOUTHWORTH.

MASSEE, GEORGE. *On the presence of sexual organs in Æcidium.* Annals of Botany, Vol. II, No. V, p. 47.

There has been much speculation among botanists as to the occurrence of antheridia and oögonia in the *Uredineæ.* The question now seems in a fair way to be settled in the affirmative.

In *Annals of Botany* for June, 1888, George Massee, of Kew, contributes an interesting illustrated paper, going to show that a distinct sexual process precedes the formation of Æcidia in this important group of plants. His discovery was made in the spring of 1883, while examining the æcidial form of *Uromyces Poæ,* Rab., which form occurs abundantly at Kew on *Ranunculus Ficaria.*

He describes and illustrates several stages. Fig. 1 shows a clavate body surrounded by a weft of hyphæ. This body, rich in granular protoplasm, was under observation some days, during which its size increased and its contents became less granular. Several refractive globules also appeared, and a nucleus was demonstrated by use of methyl-green. Fig. 2 shows an irregular oblong body much larger than Fig. 1, but otherwise resembling it; and a much narrower, curved, and blunt-pointed antheridial body arising from a distinct mycelial thread and attached by its end to the side of the oogonium. Its exact connection with the latter was not made out. Both organs are full of densely granular protoplasm, and each is separated from its hypha by a septum. By keeping this slide in water with 2 per cent. of glycerine the development of these organs was followed for two days. During this time the antheridium became empty and shriveled, while the oogonium continued densely protoplasmic, increased in size, and became somewhat pear-shaped—Fig. 3. The hyphæ beneath and around the oogonium also became much branched, forming a complex weft. Fig. 4 shows a state much further advanced, the oogonium having become nodulose, and more nearly like an ordinary æcidium. These nodules, with exception of the basal row, which forms the peridium, are said to grow into the ordinary basidia of the æcidium. It does not appear that Mr. Massee was able to trace Fig. 3 directly into Fig. 4.

For the benefit of those who wish to make observations on other æcidia it should be stated that in the æcidium on *Ranunculus ficaria* this stage was found to be very fleeting. By the time the æcidia became visible all trace of it had disappeared. Sections through the leaves should be made when the spermogonia first appear, or while the future æcidium is indicated only by the faintest discoloration.—ERWIN F. SMITH.

PRILLIEUX.—*Périthèces du Black-Rot.* Société Mycologique de France, tome IV, 2e fascicule, 1888, p. 60.

Tome IV of the reports of the Société Mycologique contains a paper by M. Ed. Prillieux upon the *Perithecia of the Black-rot* of grapes, in which there are several points worthy of special note. Prellieux believes that the pycnidia and spermogonia are changed into perithecia during the winter. After the asci had developed he found the mouth of the perithecia filled with a plug of gelatinous matter, probably composed of the remains of a layer of delicate parenchyma that bore the stylospores toward the end of summer. As the asci grow they push up this mass. The apex of the ascus is very slightly thicker than the rest of the walls, and probably becomes gelatinized when the end of a spore presses against it. In many cases, however, no opening is made, but the spores remain surrounded by a mucilaginous substance until the walls of the ascus disappear; undoubtedly the gelatinization of the apex has extended to the entire membrane. When the spores have become detached from this mass, a particle of transparent, gelatinoüs substance was seen attached to one end, probably for the purpose of fastening them to the leaves.

On the surface of berries which had passed the winter in the open air was found a dark-colored mycelium creeping over the cuticle and occasionally bearing spores on branches upright to the surface. Prillieux merely mentions their presence, and says he can not decide without further evidence as to whether they are part of the *Physalospora* or are some foreign fungus.—EFFIE A. SOUTHWORTH.

MM. PIERRE VIALA ET L. RAVAZ. *Recherches expérimentales sur les maladies de la vigne.* Comptes Rendus, tome CVI, juin 18, 1888, *p.* 1711.

The *Comptes Rendus* contains a paper by Pierre Viala and L. Ravaz, read before the *Académie des Sciences* in June, 1888. It comprises a review of the main results of their experiments on the diseases of the vine.

The proof of the genetic relationship between the different forms of black rot and between the fungus on the leaf, stem, and fruit is noted. They also record the finding of the Perithecia in France, and state that they are either developed from pre-existing pycnidia or produced directly from mycelium filaments.

Besides the notes upon Black-rot, there are some on White-rot, Anthracnose, and Mildew. White-rot was produced on healthy leaves, stems, and berries by sowing the spores of *Coniothyrium*, thus showing the parasitism of the fungus, and that it was reproduced by stylospores.

The mycelium of Anthracnose was observed in the stems in a latent condition during the winter, and the formation of conidia from the same mycelium seen the following spring.

The identity of *Oidium Tuckeri* with the conidial form of *Uncinula spiralis* was established by comparison of specimens from France and America.—EFFIE A. SOUTHWORTH.

BRIOSI and CAVARA. *Funghi parassiti delle piante coltivate od utile, essiccati, delineati e descritti.* The parasitic fungi of cultivated and useful plants. Specimens, illustrations, and descriptions.

G. Briosi and F. Cavara, the managers of the Cryptogamic Laboratory at Pavia, Italy, anticipated the first fascicle of their collection and descriptions of the parasitic fungi of cultivated and useful plants by a circular letter to possible subscribers, in which they state that the reasons which led them to make the collection was to place in the hands of farmers, schools, and agricultural colleges a publication which will present the necessary elements for the easy determination of the parasites infecting plants of economic value.

This publication, they say, will consist of (1) specimens of plants attacked by parasitic fungi; (2) a drawing of the parasite and its organs of reproduction; (3) a short and accurate description of the fungus, accompanied by an indication of the remedies that have been sanctioned by experience.

They state that this is the first publication of the kind that has ever been issued, and while its preparation requires no small amount of labor, it is undertaken in the hope that it will prove of practical value.

The first fascicle has already been received by the Section, and proves to be all that was promised in the circular letter. The drawings are not elaborate, but clear, and convey a distinct idea of the fruit of the fungus, and these, combined with the descriptions and actual specimens, furnish sufficient data for the determination of any species contained in the collection.

The text is Italian, and this will hinder many who are directly interested in agriculture from obtaining much profit from the work; but the species comprised in the first fascicle are mainly those which are common in America as well as in Italy. It seems to us that a good translation would be of great practical value. There are twenty-five species in a fascicle, and each fascicle costs 7 lire in Italy and 8 ($1.57) in other countries. They are sent post paid, neatly put up.—EFFIE A. SOUTHWORTH.

WARD H. MARSHALL. *A Lily disease.* Annals of Botany, Vol. II., No. VII, pp. 319–382, with five double plates, 60 figures.

This paper is an important contribution to our knowledge of the biology of the form-genus commonly called *Botrytis.*

Professor Ward has demonstrated that a *Botrytis* of the *Polyactis* type, found for a number of years on the spotting and rotting stems, leaves, and flower buds of *Lilium candidum*, is a true parasite and the cause of the disease. He established the uniform connection of the fungus with

the spots; produced the disease in healthy lilies by sowing conidia in drops of water on their surface; and finally saw the penetration of the germ-tube and the development of the mycelium within the tissues.

This fungus is also capable of living as a saprophyte. Many interesting cultures were made, the most important discovery being that its mycelium secretes a ferment similar to that discovered by DeBary in *Sclerotinia sclerotiorum* and capable of dissolving cellulose. This ferment is frequently excreted from the hyphæ ends in the form of small yellowish drops. When fragments of lily tissues are thrown into this liquid the cellulose walls become swollen and soft and the middle lamella disappears. Pasteur's solution, in which the fungus had been grown, produced the same effect, as did also water in which a mass of the mycelium had been bruised. Portions of the same solutions after two minutes' boiling produced no effect whatever. Evidently the boiling destroyed or dissipated the active substance. By addition of alcohol Professor Ward succeeded in obtaining a white flocculent precipitate which, when redissolved in water, produced the same effect as the excretion itself. "The middle lamellæ of all the parenchyma cells were destroyed and the cells isolated as if they had been boiled, while the cellulose walls swelled up and became distinctly lamellated and folded." He believes this white precipitate consists chiefly of a ferment related to a zymase, but he has not been able to isolate it perfectly. To its presence the hyphæ ends owe their remarkable power of boring through cellulose walls, which he observed repeatedly. The wall in front of the advancing hypha becomes swollen, softened, and finally dissolved. The rapidity with which this takes place is sometimes remarkable. In one instance it was completed in 10 minutes, in another, in 30 minutes. He thinks the irritation of contact induces a more copious production of this ferment, the extrusion of which he observed in many instances where the hyphæ ends touched the sides of flasks or the surface of slides and cover-glasses.

Another curious fact, often noticed, however, by other observers, was the anastomosing or conjugating of hyphæ. This was astonishingly frequent in cultures after the first two days, the mycelium becoming a perfect net-work by means of cross-connections. In some instances Professor Ward observed a hypha end move through an arc of more than 90 degrees for the purpose of uniting with another, and, as he remarks, "it is difficult to avoid the impression that the two or more bodies concerned are attracting one another in some way." He thinks the softening and disappearance of the hyphæ walls to form such unions is due to the presence of the previously mentioned soluble ferment. He also inclines to believe that the softening of walls, due to the localization of this ferment in given portions of the mycelium, is what determines branching. This, however, is theoretical. Mere contact of hyphæ does not always lead to their union, and it is suggested that this anastomosing may be the result of an effort "to equilibrate certain

differences which have unavoidably made themselves apparent in the metabolic processes."

Professor Ward was not able to establish the connection of this fungus with any other form, but believes it to be the conidial state of some *Peziza*, of which there would seem to be little doubt.—ERWIN F. SMITH.

EXPLANATION OF PLATES.

PLATE I.

Figs. 1-11. *Tilletia buchloëana*, Kell. & Sw. on *Buchloe dactyloides*.

1-4. Affected ovaries of various sizes, x 6.

5. A spore showing sub-reticulate markings, and pedicel of attachment (?), x 500.

6. Spore showing unusually prominent spines and two layers of the hyaline envelope, x 500.

7. An optical section of an immature spore showing the two layers of the hyaline coat; the inner extending from the wall to the tips of the spines; the outer spinose and inner lighter thinner wall; the granular layer, and the collapsed center, x 500.

8-10. Optical sections of mature spores showing but one hyaline layer; Fig. 9 shows the rudiment of the pedicel of attachment (?), x 500.

11. A male spikelet consisting of three flowers all bearing ovaries which are filled with the mass of spores.

Figs. 12-25, *Ustilago Andropogonis*, Kell. and Sw. on *Andropogon provincialis* (Figs. 12-18 on *A. provincialis*) and *A. Hallii*, Hack.

12-14. Affected ovaries of various sizes, x 3.

15. A portion of the rachis showing a normal sessile, and a pedicelled flower, also an extra short pedicelled one which (like the sessile one) bears an infested ovary, x 3.

16. A portion of the rachis bearing normal flowers, the sessile pistillate and affected, the pedicelled one staminate and free from the disease.

17. Two spores of *Ustilago andropogonis* from *A. provincialis* seen in optical section showing spines, thickness of cell-wall, and granular contents, x 500.

18. Three spores of same showing common sizes and shapes, x 500.

(Figs. 19-25, *Andropogon Hallii.*)

19-22. Affected ovaries of various sizes, x 3.

23. A portion of the rachis bearing sessile (fertile) and pedicelled (normally sterile) flowers, both producing smutted ovaries.

24. Three spores of *Ustilago andropogonis* from *A. Hallii*, showing common sizes and shapes, x 500.

25. Two spores seen in optical section showing thickness of cell-wall and granular contents, x 500. As will be seen by comparison with Fig. 17 the spores from *A. Hallii* had a slightly thicker wall than those from *A. provincialis*.

Figs. 26-40. *Ustilago boutelouæ*, Kell. & Sw. on *Bouteloua oligostachya*.

26-28. Affected ovaries of various sizes, x 6.

29. An affected spikelet distended and the palet split by the enlarged smutted ovary, x 6.

30. Six spores showing common sizes and shapes, x 500.

31. Three spores seen in optical section showing spines, thickness of wall and slightly granular and guttate ? contents, x 500.

(Figs. 32–40 showing germination of spores of *Ustilago bouteloua* in distilled water on slide in damp chamber 24 hours at 37° C.; collected December 20, 1888, germinated February 20, 1889.)

32. Spore showing cleft in the wall and young promycelium, x 500.
33. Spore bearing a branched promycelium which has split the cell-wall and about to produce a sporidium on the side (?), x 500.
34. Spore showing two promycelia, the one scarcely developed, x 500.
35. Spore seen in optical section showing a slender promycelium apparently connected with the contained gutta, x 500.
36. A spore with a more mature promycelium which is either branched and bearing a sporidium at the end of the branch, or a primary sporidium is producing a secondary one, x 500.
37. A free sporidium budding, x 500.
38. A promycelium broken off from the spore, bearing two sporidia from below the septa, x 500.
39. A free promycelium bearing a single sporidium, x 500.
40. A slender free promycelium producing a single sporidium, x 500.

PLATE II.

Fig. 1. Cross-section of cells of normal ground tissue; *a*, intercellular spaces.

2. Longitudinal section of cells of normal ground tissue.
3. A section of a portion of the normal epidermis with the underlying parts; *a*, epidermal cells; *b*, sub-epidermal layers; *c*, cells of the ground tissue.

PLATE III.

4. Cross-section of a normal fibro-vascular bundle; *a*, intercellular canal; *b*, annular vessel; *c*, pitted ducts; *d*, phloëm; *e*, elements of the bundle sheath.
5. Longitudinal section of a normal bundle; *a*, cells of ground tissue; *b*, elements of bundle sheath; *c*, cambiform cells; *d*, sieve tubes; *e*, tracheid; *f*, portions of an annular vessel; *g*, intercellular passage; *h*, wood parenchyma.

PLATE IV.

6. Longitudinal section of normal epidermis; *a*, large; *b*, small cells of epidermis; *c*, sub-epidermal cells.
7. Surface view of normal epidermis; *a*, large; *d*, small cells; *b*, guard cells; and *c*, accessory cells of the stomata.
8. Diagram of a section of a stem with the abnormal growth; *a*, *b*, stem; *c*, abnormal growth; *e*, bundles; *d*, region of active growth. The light shading represents ground tissue cells, the dark shading masses of spores, and the lines in *c* the bundles sent out to the abnormal growth.
9. Section similar to that represented in Fig. 3, except that it is slightly distorted; *a*, epidermal and sub-epidermal layers; *b*, ground tissue cells; *c*, portion of a bundle.
10. Surface view of epidermis of abnormal tissue; *a*, epidermal cell; *b*, nucleus.

11, 12. Surface view of abnormal tissue showing distortion of stomata; *a* guard, cells; *b*, accessory cells; *c*, epidermal cell.

PLATE V.

13, 14. Surface view of abnormal tissue showing distortion of stomata; *a*, guard cells; *b*, accessory cells; *c*, epidermal cell.

15. Cross-section of cells of abnormal ground tissue in region of active growth, showing nucleii.

16. Cross-section of the same a little nearer the periphery nucleii not so conspicuous, and are not represented.

17. Cross-section of the same still nearer the periphery.

PLATE VI.

18. Cross-section of the same near the periphery with *a*, the epidermal cells.

19. Cross-section of a distorted bundle; *a*, intercellular canal; *b*, annular vessel; *c*, pitted duct; *e*, element of bundle sheath; *f*, wood parenchyma.

PLATE VII.

20. A section in abnormal tissue showing *a*, longitudinal section of a bundle, also a mass of mycelium filaments in early fruiting stage.

21. Longitudinal section of a more typical abnormal bundle; *a*, branch of the bundle.

22. Cross-section of the abnormal bundle.

23. Mycelium filament.

24. Mycelium filaments running through cells of the ground tissue.

25. Early stage of spore formation.

26: Later stage of spore formation.

27. Mature spore.

— = .01^{mm}, scale to which the figures are drawn.

PLATE VIII.

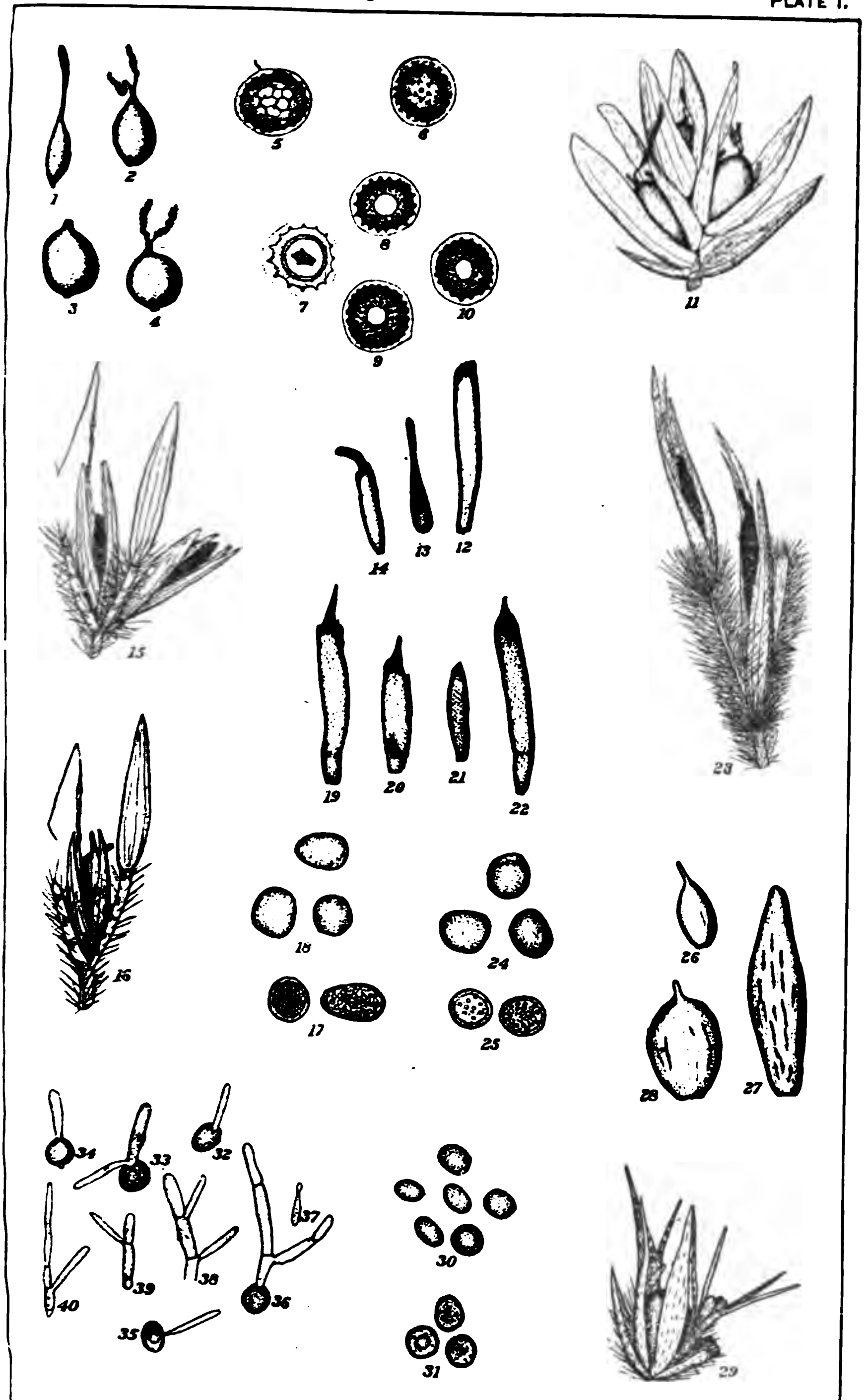
Fig. 1. Upper surface of pileus of *Mucronoporus tomentosus*, Fr.

2. Lower surface of same.

3. Section of pores showing the projecting points or spines.

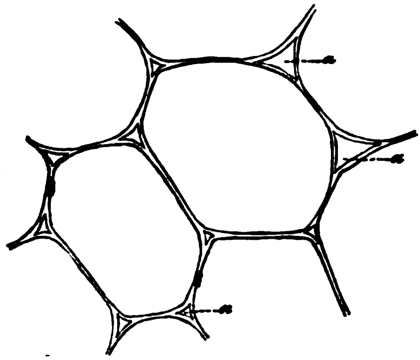
4. One of these spines more highly magnified.

5. Spine with a bifid tip.



Kellerman & Swingle, del.

KELLERMAN AND SWINGLE ON NEW SPECIES OF KANSAS FUNGI.



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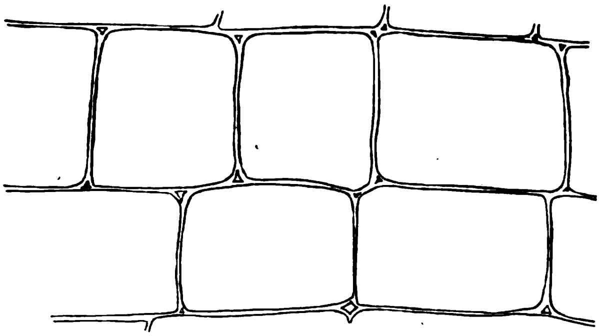

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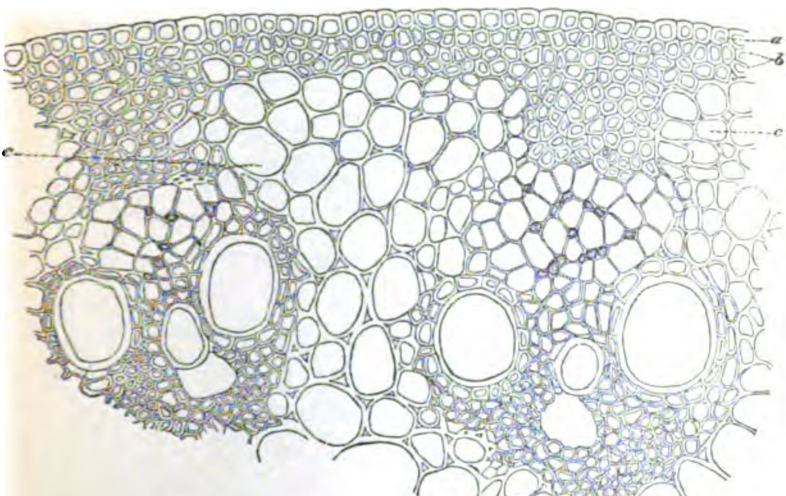

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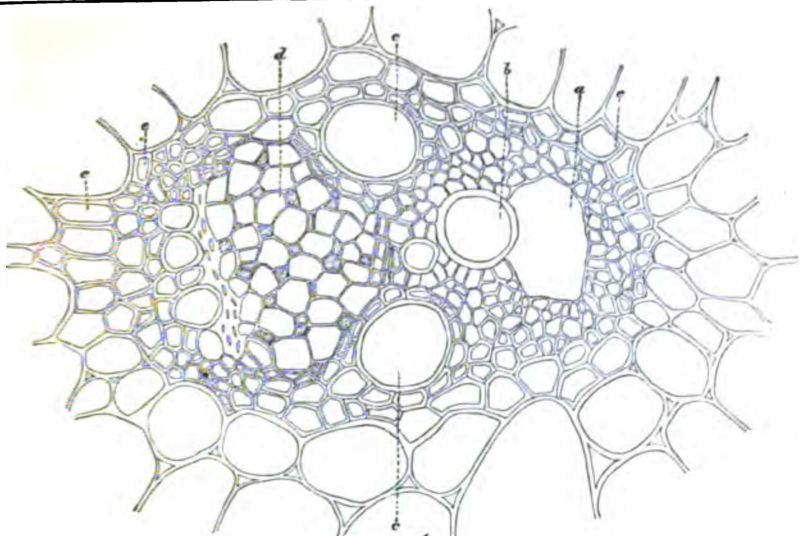
E. L. Knowles, del.

KNOWLES ON USTILAGO ZEÆ-MAYS.



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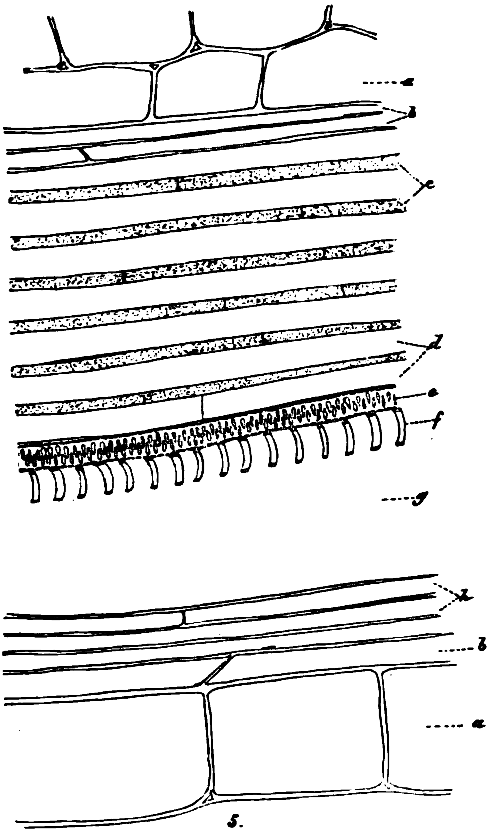

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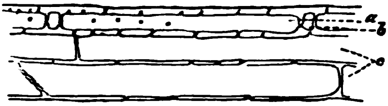

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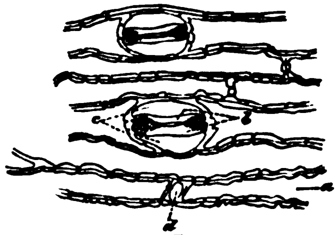

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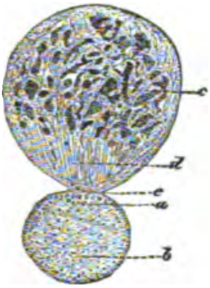

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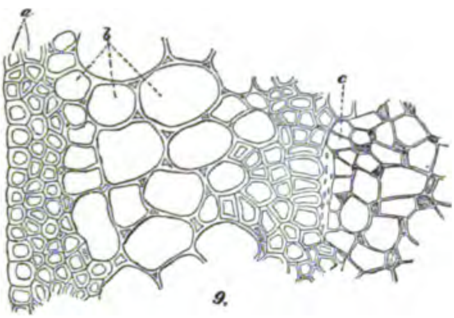

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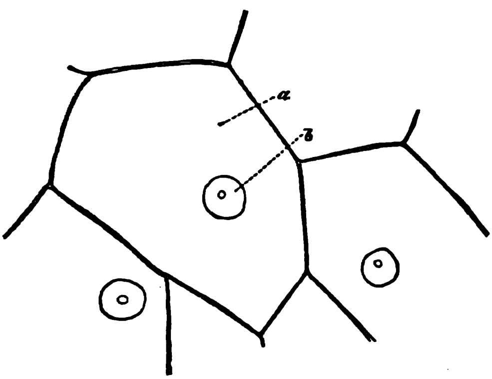

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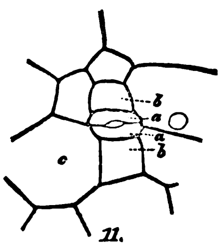

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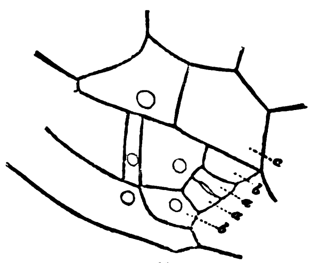

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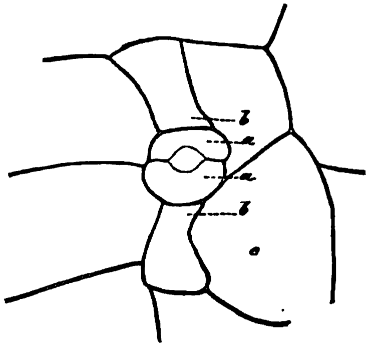

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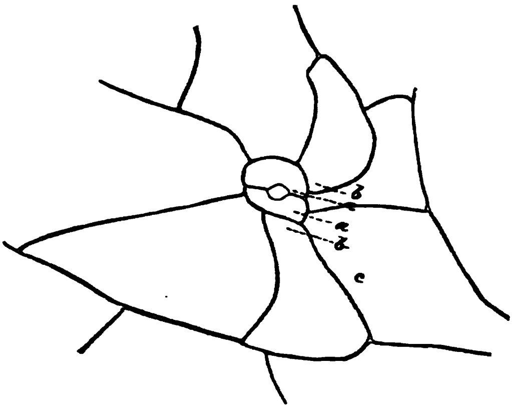

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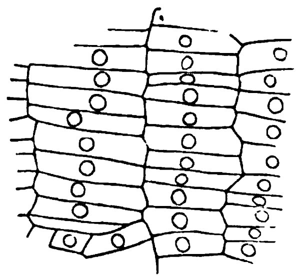

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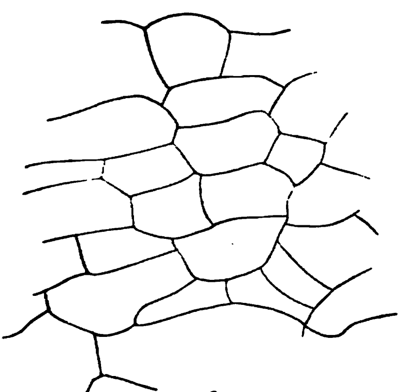

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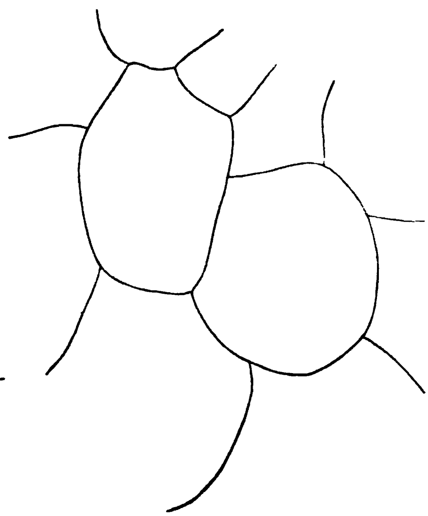

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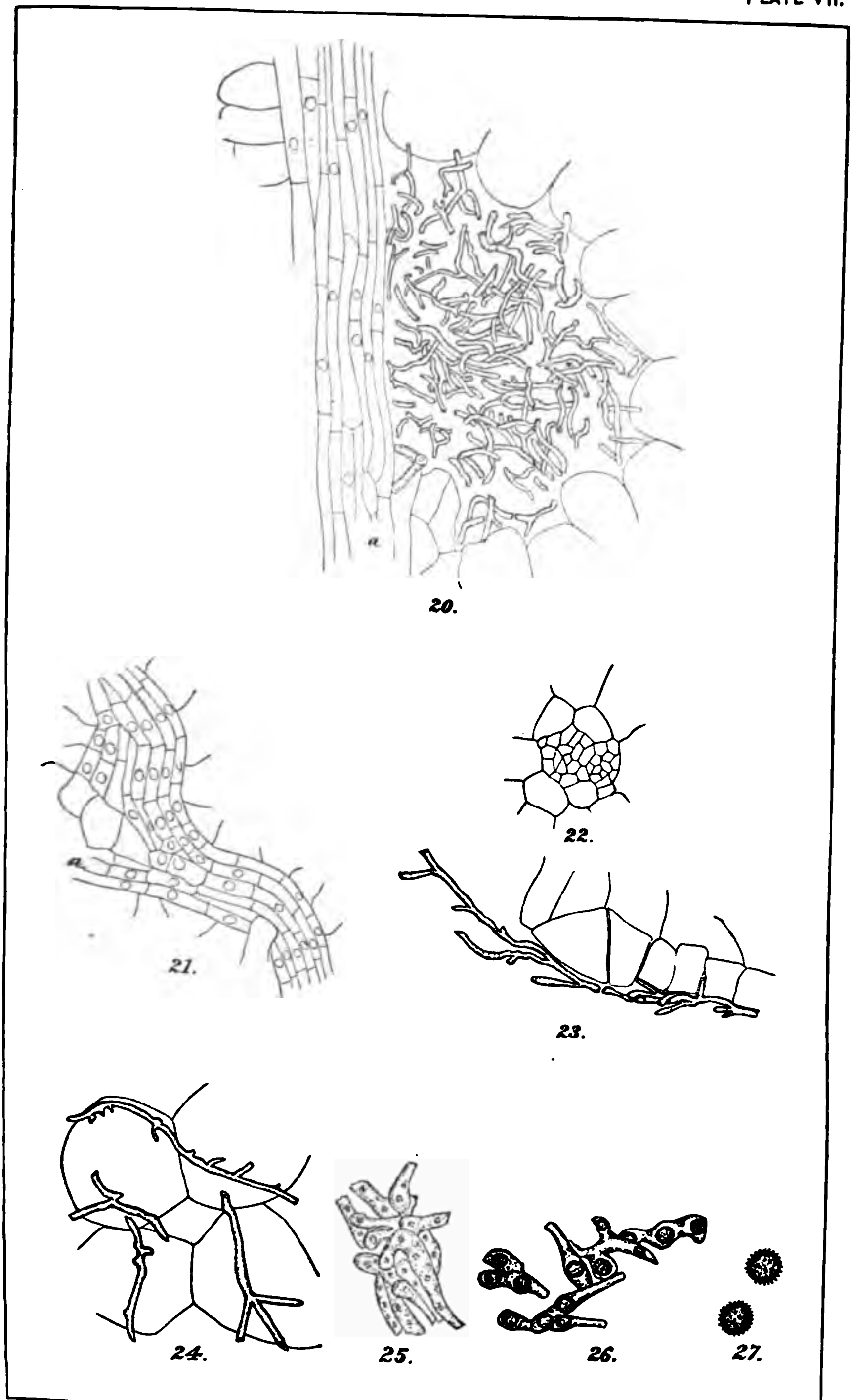
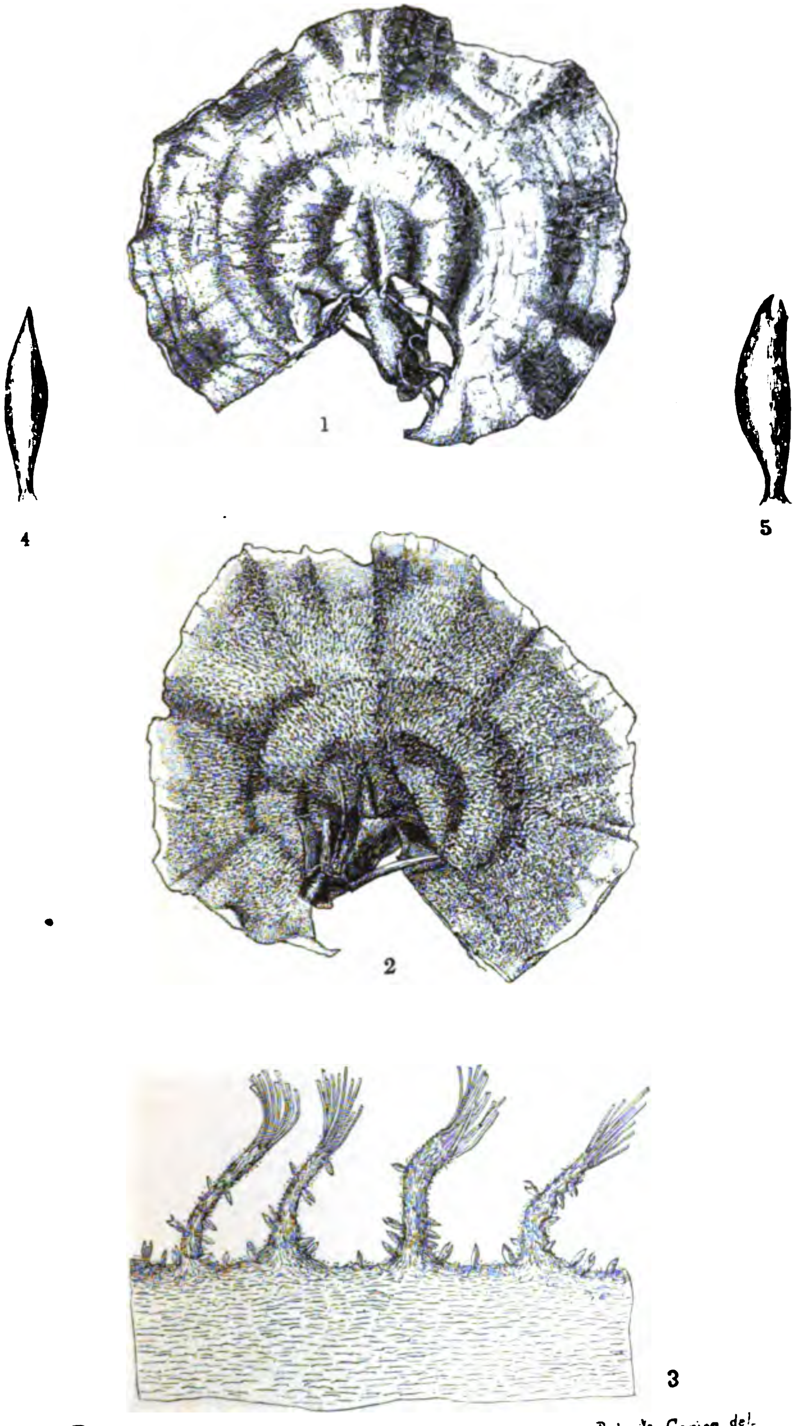


E. L. Knowles, del.

KNOWLES ON USTILAGO ZEÆ-MAYS.

Journal of Mycology, U. S. Department of Agriculture, 1889.

PLATE VIII.



Sc. Roberta Cowing del.

ELLIS ON MUCRONOPORUS TOMENTOSUS, FR.

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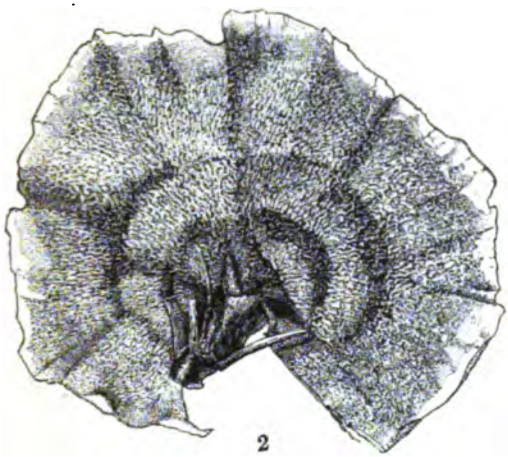

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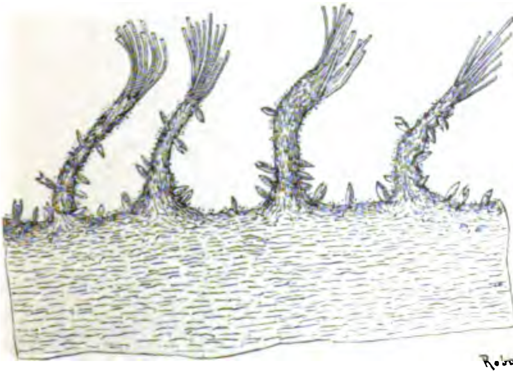

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Roberta Cowing del.

Sc.

ELLIS ON MUCRONOPORUS TOMENTOSUS, FR.

U. S. DEPARTMENT OF AGRICULTURE.
SECTION OF VEGETABLE PATHOLOGY.
QUARTERLY BULLETIN. JUNE, 1889.
Vol. 5. No. II.

THE JOURNAL OF MYCOLOGY:

DEVOTED TO THE STUDY OF FUNGI,

ESPECIALLY IN THEIR RELATION TO PLANT DISEASES.

PREPARED, UNDER THE DIRECTION OF THE SECRETARY OF AGRICULTURE,
BY

B. T. GALLOWAY,
CHIEF OF THE SECTION.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1889.

CONTENTS.

GLŒOSPORIUM NERVISEQUUM, (FCKL.) SACC.

By E. A. Southworth.

The sycamore blight caused by the fungus *Glœosporium nervisequum* has been very abundant in various parts of the country for the past few years. In some cases trees have been killed outright by the disease and in many the growth of the early part of the year has been completely destroyed. The sycamore is extensively planted as a shade tree, and its wood is used almost exclusively for making tobacco boxes. It is stated that one mill on the Embarras River in southern Illinois has within a few months received orders for 11,000,000 feet of sycamore lumber, and that other mills throughout that region are busy sawing up the great trees. If this demand continues it will soon be necessary to take some steps to keep up the sycamore supply, but when the trees are attacked each year with a destructive disease their existence is seriously threatened. Effects of the disease are so prominent that during and soon after its active season trees which have been affected can be readily distinguished for a long distance. Fortunately for the trees, the disease continues active only a small portion of the year, and during the greater part of the summer they have a chance to partially recover from the disastrous effects of the attack. But even under these favorable circumstances, it is evident that the growth is greatly retarded. Last spring the disease attacked full-grown and young leaves, mostly near the ends of branches. Sometimes the young unlignified stem was attacked at some distance from the end, and then, of course, all the leaves beyond this point would wilt, although no fungus could be discovered on them. The petioles were very commonly attacked. The trees thus diseased had a scorched and wilted appearance.

This spring the attack in Washington was quite different. Comparatively few full-grown leaves were affected, but the external leaves of the unfolding buds showed the disease as soon as they were half out, and many entire buds died before they were fairly open. In other cases the

inner leaves grew out without showing any traces of the disease. In fact, nearly every stage was present between buds which were quite dead before winter was over and buds which opened in a healthy and natural manner. The general impression gained from an examination of the trees when the first leaves were about half grown was that the buds must have been infected in some cases by spores which had lodged on them before they started to grow, and that in others the mycelium must have entered them from the branch. Those buds of which only the outer leaves were affected belong to the former class, and those which shriveled up because the axis that was still in a meristematic condition was attacked, belong to the latter. This is, however, merely a surmise, for it is quite possible that this case was simply caused by spores which had been washed by the rains further into the folds of the buds, and were consequently in a position where their germ tubes could penetrate the axis itself, and the mycelium produced from them enter the woody portions through the more delicate tissues of the bud. One thing, however, seems evident, this attack, which showed itself so early in the spring, can not be due to the same infection which now produces the characteristic spots of *Glœosporium nervisequum* along the veins of some of the full-grown leaves. The disease is very scarce in Washington at present, but in other parts of the country the same state of affairs exists that existed here last spring. The leaves are for the great part diseased, some showing large brown patches, others withered from the effects of a diseased petiole or growing branch, and the ground is covered under the trees by leaves which have fallen from the effects of the fungus at the base of the petiole.

The existence of large numbers of dead twigs on the trees at the time the blight is most active, and the appearance of other leaf fungi after the *Glœosporium* has ceased its attacks, raise the question at once whether some of these do not have some connection with the leaf blight. I have studied the question for some time. but all my experiments have produced merely negative results.

The following paper by Franz von Tavel contains descriptions of some of the most prevalent and important of these forms, together with detailed accounts of his experiments made with a view of determining their life history. It probably represents our best knowledge of the subject. The paper was published in German in the *Botanische Zeitung* for 1886; only a portion is printed in this number of the Journal, but the remainder will appear in succeeding numbers.

CONTRIBUTIONS TO THE HISTORY OF THE DEVELOPMENT OF THE PYRENOMYCETES. *

(Plate IX.)

By FRANZ VON TAVEL.

The *Ascomycetes* have already been the object of many researches resulting in a series of most interesting facts which in turn always suggest new questions. To solve these requires investigations in two directions. First, the development and significance of the separate organs, especially of the pycnidia and perithecia, should be better established. Athough much has been done in this respect, still the manifold forms of the *Ascomycetes* leave many new facts to be expected, and the results already obtained are too scattered to admit of any generalization. Second, the life history of the pleomorphic forms demands thorough investigation. We know a large number of pycnidia and other gonidia forms, and conclude that each represents a stage in the development of an Ascomycete, but this has been definitely proved in only a very few cases.

What follows contains a series of observations in the two directions already indicated, having as their object some gonidia forms and *Pyrenomycetes* of doubtful relationship, but not giving a complete chain of development. We will first attempt to solve the question as to what cycle of development the common *Glœosporium nervisequum*, (Fckl.) Sacc., a dangerous enemy to the sycamore trees, belongs. For reasons given below the question must remain almost entirely unanswered, but other forms of fungi were found in the course of these investigations. A pycnidium, *Discula platani*, (Pk.) Sacc., is suspected of belonging to the same cycle of development as the *Glœosporium* and was consequently very closely investigated. Together with this *Discula* appeared a *Fenestella* whose life history could only be established to a certain degree of completion. A *Cucurbitaria* found growing with the two other forms was studied in relation to the development of its pycnidium, more exhaustive observations being prevented by the lack of material. In what follows I have brought together my observations on these four forms.

It should be mentioned that the three last-named fungi live on dry branches. It is well known that these, like lichens that grow upon bark, can not be cultivated except with difficulty. Hitherto they have only attained a limited age in culture fluids. It is extremely difficult to cultivate them on dry twigs because it is impossible to sterilize other twigs without destroying the objects of our observations, and foreign fungi, which make observations difficult and results uncertain, invade the cultures and in many cases so get the upper hand as to destroy all other fungi. *Tricothecium roseum*, Lk., is an especially dangerous fungus.

* *Bot. Zeitung*, 1886, p. 824.

It is with difficulty that a twig can be kept in a moist chamber without this species making its appearance.

I. GLŒOSPORIUM NERVISEQUUM, (Fckl.) Sacc.

The *Platanus* (sycamore) frequently exhibits an epidemic disease that is especially injurious to the young trees. The first manifestation of the malady is the wilting of the young leaves. Soon after they unfold, about the middle of May, brown spots make their appearance on any portion, and extend along a vein, toward the base, over the leaf, and even on the pedicel, until the leaf finally falls off. Upon these dry places are small black dots just visible to the naked eye, and representing the gonidial form of a fungus probably belonging to the *Pyrenomycetes*. It has been seen in most cases on *Platanus occidentalis*.* Léveillé, Fuckel, and Saccardo state that it also occurs on *Platanus orientalis*, but I have not been able to prove these statements. In addition to this, Fuckel refers to a form growing on the oak,† which he has distributed in his F. Rhen. No. 428.

This fungus has been known for a long time. It was first described by Léveillé as *Hymenula platani* in 1848, but it is surprising that neither he, Fuckel, or Saccardo mention its destructiveness. In his *Symbolæ*, p. 369, Fuckel cites it as *Fusarium nervisequum* and gives an illustration of one of the spores. In the F. Rhen. No. 427 it is called *Labrella ? nervisequum*, Fckl. Saccardo placed the fungus in the broader genus *Glœosporium* and adopted Fuckel's specific name, since a *Glœosporium platani*, (Mont.) already existed. It is therefore known as *Glœosporium nervisequum*, (Fckl.) Sacc.

If the infected areas are placed under a low magnifying power they show brown or black pustules which are elongated in form and most generally located in the angle formed by the vein and the leaf surface, but are also found on both these parts. Generally they occur upon the upper side of the leaf; much more rarely upon the lower.

The structure of the fungus may be seen in a cross-section of one of these pustules (Fig. 1). The fungus destroys the walls between the epidermal cells, and the outer wall with the cuticle arches up until it bursts when the spores are ripe. The base of the pustule is lined with a pseudo-parenchymatic tissue composed of small cells which may be called a stroma. From this arise numerous hyphæ which penetrate the leaf, passing between the cells and completely destroying the leaf tissues. From the upper side of the stroma numerous hyphæ or basidia grow out into the cavity of the pustule. These swell up and become club-shaped and cut off spores from the end. They are of unequal lengths, and the club-shaped swellings begin with the growth of the basidia. The spores are detached in great numbers; when the epidermis ruptures they exude in the form of a worm-like, whitish-yellow mass. They are very irregular in shape, being mostly elliptical or pear-shaped, and

* It has been found in California on *P. orientalis* by Harkness.

† Specimens on oak have been sent to the Department from Indiana.

are always one-celled and colorless (Fig. 2). The smooth, delicate spore membrane is surrounded by a gelatinous envelope. The spores measure 9-14 by 5-6μ, agreeing with the measurements made by Fuckel and Saccardo. They germinate in a few hours in water or a nutrient solution, and develop a germ tube which soon branches and forms septa; the cells lying next to the spore swell more or less.

A mycelium is formed in a few days by means of the rapid growth of the germ tube and repeated branching. The hyphæ are of unequal diameter, and are made up of short, often somewhat swollen cells. When the mycelium grows in a nutrient solution gonidia are formed after some time. The short cells of the thicker hyphæ develop outgrowths which are cut off, the mother cell and gonidia both being filled with dense protoplasm; or on the other hand, the hyphæ cells may first develop basidia, which cut off spores from the end. Both forms of development may occur simultaneously on the same hyphæ. The gonidia themselves are alike, and agree in form and size with those produced on the leaf excepting that they are a little more regular. From this, and from the fact that the gonidia are produced more abundantly where the hyphæ are more closely interwoven, we may conclude that the gonidia produced in culture on the slide are homologous with those produced on the leaf, and that the hymenium not attaining to the same degree of development is due to the changed mode of growth. This question can not be definitely decided, for the fungus on the slide did not develop farther, and attempts at infection were without result.

Leaves of *Platanus* were infected with the *Glœosporium* in the most varied ways—upon the upper and lower surface, upon young and old leaves, on detached branches and uninjured trees; the cultures were kept moist and dry, and the germinating power of the spores was controlled by cultures on slides, but not a single infection gave a positive result. It can therefore at present only be said in regard to the life history of the *Glœosporium nervisequum* that the gonidia will produce a similar gonidial stage on the slide.

Is it possible, then, to draw the conclusion that this closes the life history of the fungus; that is, that it has lost the perithecia and pycnidia stages, as has been supposed true of *Botrytis bassii*, *Isaria strigosa*, and *Oidium lactis*, although we are by no means forced to such a conclusion? If this is true, we must assume that the spores fall to the ground, survive the winter among the fallen leaves, and in the spring are carried to the leaves by means of the wind or some other agent. This inference is supported by the fact that the disease begins nearest the ground. The leaves on the lower branches wither first; the upper ones gradually follow. On the other hand, it is not conceivable that these delicate, thin-walled spores could survive the winter lying upon the damp earth, especially since they germinate very readily on the slide upon the addition of moisture without requiring a resting period. And if these were the agents in the penetration of the leaves it is not likely that all

our experiments would meet with negative results. The evidence rather points towards discarding the idea that *Glœosoporium nervisequum* has no other stages in its life history.

It has not yet been possible to find out these other stages; the cultures could not be carried far enough, and forms that might belong to the *Glœosporium* were found in the open air on fallen leaves and dry branches, but we were not able to establish the connection. One form which we especially suspected of organic relationship, on account of its morphological evidence, is described in detail in what follows.

II. Discula platani, (Pk.) Sacc.

Upon *Platanus* trees attacked by *Glœosporium* there are many dry branches of the previous year's growth, which died after all the leaves had fallen, and before the close of the vegetative period. Upon these are usually a large number of small pustules which finally split open. At first they look very much like lenticels, and can scarcely be distinguished from them by the naked eye; but when one of these twigs is moistened small yellowish columns emerge from all the openings; these columns are composed of spores, and show the presence of a fungus.

The structure of the fungus may easily be studied in a cross-section of the branch. The young pustules are filled with a pseudo-parenchymatic tissue which rests upon the green part of the bark and penetrates it slightly. Above (by above is meant the side turned away from the twig) the fungus pushes up the bark until it finally bursts (Fig. 3). The tissue is then in the form of a cone. The basal cells are nearly isodiametric and polygonal, but the upper ones are elongated and lie more or less parallel. The point of the cone does not project beyond the bark, and the hyphæ are more apt to swell up when they reach the surface. The entire cone shows a strong upward growth which has its origin in the lower cell layer. This layer has here the function of meristem and pushes up other portions of the cone by the elongation of its cells.

In more advanced stages pseudo-parenchyma is also developed in the uppermost layer of bark parenchyma whose cells have been completely destroyed. A cavity quickly arises in the cone by the cessation of growth in the central part (Fig. 4). Hyphæ very quickly grow out into the cavity from all sides and clothe it with a hymenium which produces spores by successive abscision. The cavity enlarges especially towards the surface; the remains of the parenchyma together with the cone above them are pushed up considerably, enlarging the slit in the bark. The hyphæ forming the cone generally become completely obliterated; very rarely only a pore is formed therein; by these processes the hymenium is exposed. The outer portions become dark colored and the entire pustule is more or less bowl-shaped (Fig. 5).

The basidia are unbranched, slender, and cylindrical. The spores are

one-celled, colorless, oval to pyriform, surrounded by a thin gelatinous envelope, and measure 10–14 by 5–7μ. They have a striking resemblance to the spores of *Glœosporium nervisequum*.

It is evident from the form of the open conceptacle that the fungus belongs to the *Excipulaceæ*. It agrees perfectly with the description of *Discula platani* Peck (Sacc. Syll., Vol. III, p. 694).

On account of its mode of development *Discula platani* must be regarded as a pycnidium, but it differs in several points from what we usually call pycnidia. The body of tissue remains intact longer than is usual and it is also different in being differentiated into two kinds of tissue. The upper part of the pycnidium with the elongated cells corresponds with similar formations on the walls of other pycnidia, as will be shown below in case of *Fenestella* (Fig. 11). The pore always makes its appearance at the spot where the elongated cells were developed. In *Discula* this attains such very considerable dimensions that the entire pycnidium is destroyed down to the bowl-shaped basal portion, and besides this the phenomena of growth are peculiar to *Discula*. *Discula* does not, however, stand alone in this. Banke (Beitr. z. Kenntn. d. Pycniden in Nova Acta Acad., Leopold., XXXVIII, p. 481) demonstrated an apical growth of the pycnidia of *Pleospora polytricha*.

Nothing is known concerning the farther development of the *Discula*. In fact it was only in rare cases that we succeeded in following the development until the hymenium was exposed. A few days after the branches were brought into the house *Tricothecium roseum* attacked the pycnidia where they had broken through the bark and completely destroyed them.

When sowed in water or nutritive fluid the spores of *Discula* germinate in about twenty-four hours. They generally give rise to two, more rarely one or three, germ tubes, which swell up, forming spherical bodies. The growth is at first similar to the budding that occurs in yeast, showing repeated branching and budding, surrounding the spore in a dense tangle. One of the branches finally exhibits a decided apical growth and develops into a hypha branching monopodially. No septa are present for some time, but they appear later in considerable numbers. A vigorous mycelium develops rapidly but it never attains the production of spores. Frequently a few cells either at the ends or along the course of the hyphæ swell up and assume a spherical shape, and sometimes this happens for two adjacent cells; in the latter case the sphere is divided by a septum. The contents is watery and the protoplasm simply forms a lining within the wall.

Leaves and branches of *Platanus* were inoculated with *Discula* in the same manner as with the *Glœosporium* but with no results. The leaves remained fresh for a long time and then began to wither and turn brown without showing any signs of a fungus.

Discula platani is found on dry branches of *Platanus* during the entire year, and it was once discovered upon the petiole of a large decaying

leaf, in December. Owing to the fact that it is always found associated with *Glœosporium nervisequum* and in its immediate vicinity, it is suspected that the two are stages in the development of the same fungus the more so because the spores are so very similar. It is conceivable that the mycelium passes from the petioles into the branches and there produces the pycnidia of *Discula* whose spores develop into *Glœosporium* upon the leaves.* But such a connection could not be established either by natural or artificial methods, and the question still remains an open one.

(To be continued.)

NORTH AMERICAN AGARICS.

(Genus *Russula* (*russulus*, reddish). Fr. Hym. Eur., p. 439.)

By Robert K. Macadam.

Part I.

Pileus fleshy, convex then expanded, and at length depressed; stem *stout*, polished, *not corticate*, generally *spongy* within, confluent with the hymenophore; gills *nearly equal*, *milkless*, *rigid*, *brittle*, with an acute edge, sometimes dropping *water*; trama vesiculose; veil entirely *obsolete*; spores white or very pale yellow, generally echinulate.

Habitat.—On the ground, generally in woods or the vicinity of trees in summer and autumn.

This genus is interesting on account of the beauty and brilliant coloring of many of its species, and especially so to amateurs, as it is one of the few divisions of *Agaricini* which can be readily distinguished. Members of it may be recognized by the stout spongy stem, dry texture, and extreme brittleness; they are generally found in grassy woods and are of nearly all colors, frequently with the cap a brilliant red, pure white, or white blotched or shaded with red. *Russula* is allied to *Lactarius*, but is distinctly separated by the absence of *milk* in the gills; those of some *Russulæ* distill drops of water, especially in rainy weather. The internal structure is also related, as shown by the presence, in the acrid species, of the milk-secreting vessels of *Lactarius*, but in an undeveloped form.

* At the bases of the infected shoots this spring there was almost invariably a dead area on the lignified branch, and mycelium was invariably present in the tissues; this mycelium penetrated into the vessels of the wood and could not be morphologically distinguished from that in leaves infested with *G. nervisequum*. Many buds had died either in late autumn or during winter and there were similar but larger dead areas around them, and in these *Discula platani* often made its appearance. Indeed, it is almost impossible to avoid the conclusion that the mycelium of *Glœosporium nervisequum* extends into the woody parts of the branches, where the fruit of the fungus assumes a different form. The formation of the mass of pseudo-parenchyma may possibly be explained on the ground that it is necessary in order to rupture the epidermis and cork layer of the bark; and when this is accomplished it disappears.—E. A. S.

The genus contains some of the best edible mushrooms and others which are extremely poisonous, and, on account of the extreme variability of color, they often resemble each other so closely that the amateur must depend entirely upon taste in selecting the esculent ones.

Taste a piece of the stem of *each* plant as gathered and reject all not having a mild and pleasing flavor, as all the known noxious species are acrid or unpleasant. Be sure that your plant is a *Russula*, as this rule is *not* universal and *must not* be applied to mushrooms in general. The application of this method will enable the novice to enjoy some of the best viands in this class.

"I. COMPACTÆ (*compingo*, to put together; compact). Pileus fleshy throughout, hence the margin is at first bent inwards and always without striæ, without a distinct viscous pellicle (in consequence of which the color is not variable, but only changes with age and the state of the atmosphere). Flesh compact, firm. Stem solid, fleshy. Gills unequal.

"II. FURCATÆ (*furca*, a fork. With *forked* gills). Pileus compact, firm, covered with a thin, closely adnate pellicle, which at length disappears, margin abruptly thin, at first inflexed, then spreading, acute, even. Stem at first compact, at length spongy-soft within. Gills *somewhat forked*, with a few shorter ones intermixed, commonly attenuated at both ends, thin and normally narrow.

"III. RIGIDÆ (*rigidus*, rigid). Pileus without a viscid pellicle, *absolutely dry*, *rigid*, *the cuticle commonly breaking up into flocci or granules*. Flesh thick, compact, firm, vanishing away short of the margin, which is straight (never involute), soon spreading, and always *without striæ*. Stem solid, at first hard, then softer and spongy. Gills, a few dimidiate, others divided, rigid, *dilated in front and running out with a very broad rounded apex*, whence the margin of the pileus becomes obtuse and is not inflexed. *Exceedingly handsome* but rather rare.

"IV. HETEROPHYLLÆ (*R. heterophylla*, the typical species of the section). Pileus fleshy, firm, with a thin margin, which is at first inflexed, then expanded and striate, covered with a thin, adnate pellicle. The gills consist of many shorter ones mixed with longer ones along with others which are forked. Stem solid, stout, spongy within.

"V. FRAGILES (*fragilis*, fragile or brittle). Pileus more or less fleshy, rigid-fragile, covered with a pellicle which is always continuous and in wet weather viscid and somewhat separable; margin membranaceous, at first convergent and not involute, in full-grown plants commonly sulcate and tubercular. Flesh commonly floccose, lax friable. Stem spongy, at length wholly soft and hollow. Gills almost all equal, simple, broadening in front, free in the pileus when closed. Several doubtful forms occur. *R. integra* is specially fallacious from the variety of its colors.

"* *Gills and spores white.*

"* * *Gills and spores white, then light-yellowish or bright lemon-yellow.*

"* * * *Gills and spores ochraceous.*"—STEVENSON.

I. COMPACTÆ.

1. "R. NIGRICANS, (Bull.) Fr., Hym. Eur., p. 439; Cke. 111, 1015; Stev., B. F., p. 114; Sacc., Syll., p. 453. Pileus 2–4 inches (5–10 centimeters) and more broad, olivaceous-fuliginous, *at length black*, fleshy to the margin which is at first bent inwards, convex, then flattened, umbilicato-depressed, when young and moist slightly viscid and even (without a separable pellicle), at length rimose-squamulose; flesh firm, white, when broken becoming red on exposure to the air. Stem 1 inch (2.5 centimeters) thick, persistently solid, equal, pallid when young, *at length black*. Gills *rounded* behind, slightly annexed, *thick*, *distant*, unequal, paler, reddening when touched.

"Compact, obese, inodorous within and without, *at length wholly black*, in which it differs from all others. The flesh becomes red when broken because it is saturated with red juice, although it does not exude milk. Sometimes a very few of the gills are dimidiate. In woods. Common. June–November. Spores papillose, 8μ. W. G. S. Coarse in habit. Name—*nigrico*, to be blackish. (Fr., Monogr., ii, p. 184; Berk. Out., p. 209; C. Hbk., n. 613; S. Mycol. Scot., n. 582; Hussey, i, t. 73; Ag. Bull., t. 579. f. 2, t. 212; Krombh., t. 70, f. 14, 15; Barla, t. 17; Sow., t. 36.)"—Stevenson.

Taste disagreeable. Massachusetts,* Frost; Minnesota, common, July and August, Johnson; New York, our specimens agree with the description in every respect, except that the gills are not distant, August and September, Peck, thirty-second report; New Jersey, Ellis.

2. "R. ADUSTA, (Pers.) Fr., Hym. Eur., p. 439; Stev., B. F., p. 114; Sacc., Syll., p. 454. Pileus pallid or whitish, *cinereous-fuliginous*, equally fleshy, compact, depressed then somewhat infundibuliform, margin at first inflexed, smooth, then erect, without striæ; flesh unchangeable. Stem solid, obese, of the same color as the pileus. Gills adnate, then decurrent, *thin*, *crowded*, unequal, white, then dingy, not reddening when touched.

"It can only be compared with *R. nigricans*, but is sufficiently distinct; stature commonly smaller, flesh juiceless, not reddening, etc. The pileus does not become black, but only of a scorched appearance. In woods. Frequent. August to October. 'Well distinguished by its thin, crowded gills,' etc. M. J. B. 'Spores sphæroid, echinulate, 7–9μ, globose, rough, 8.' C. B. P. Name—*aduro*, to scorch, from its scorched appearance. (Fr., Monogr., ii, p. 184; Berk. Out., p. 209; C. Hbk., n. 614; S. Mycol. Scot., n. 583; Ag., Pers. Krombh., t. 70, f. 7–11; Batt., t. 13.)"—Stevenson.

North Carolina and Pennsylvania, Schweinitz; North Carolina, woods and thickets, Curtis; Massachusetts, Frost; Minnesota, September and October, Johnson; California, Harkness and Moore; Nova Scotia, pine woods, September, Somers, R. J. Bennett.

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* These references are placed with regard to the order of their dates.

3. "R. DELICA, Fr., Hym. Eur., p. 440; Stev., R. F., p. 115; Sacc. Syll., p. 455. Pileus white, 3–5 inches (7.5–12 centimeters) broad, fleshy throughout, firm, umbilicate then infundibuliform, regular, everywhere even, smooth with a *whitish* luster, the involute margin without striæ; flesh firm, juiceless, not very thick, white. Stem curt, 1-2 inches (2.5–5 centimeters) long, ½ inch (12^{mm}) and more thick, solid, even, smooth, white. Gills *decurrent, thin, distant,* very unequal, white, exuding small watery drops in wet weather.

"The stature and *unchangeable colors* are wholly those of *L. vellereus* and *L. piperatus,* but it is readily distinguished *by the gills being juiceless,* though they exude watery drops when young. In mixed woods. Uncommon. September–October. Name—*delicus,* weaned; without juice or milk in the gills, as distinguished from *L. vellereus,* etc. (Fr., Monogr., ii, p. 185; Berk. Out., p. 210; C. Hbk., n. 615; S. Mycol. Scot., n. 585; Vent., t. 48 f. 3, 4; Batt., t. 17 A; Paul., t. 73 f. I,") Stevenson.

"Edible. Taste mild. Spores 8–10 by 6–8μ. Sacc., Syll. From the juiceless variety of *Lact. vellereus* its mild taste alone furnishes a separating character."—Peck.

A large, coarse species, cup-shaped at maturity. I have found it in several localities in Massachusetts in July and August. It is of fair quality, cooked, but much inferior to *R. virescens,* etc. Minnesota, in woods, August, Johnson; New York, Peck, 32d Report; California, Harkness & Moore.

4. "R. SORDIDA, Peck, 26th Rep. N. Y. State Mus. Nat. Hist., 1874, p. 65; Sacc., Syll., p. 459. Pileus 3–5 inches (7.5 centimeters) broad, firm, convex, centrally depressed, dry, sordid white, sometimes clouded with brown; gills close, white, some of them forked. Stem 4–5 inches (10–12.5 centimeters) long, ½–1 inch ($12–24^{mm}$) thick, equal, solid, concolorous; spores globose, .0003 inch (7.5μ); taste acrid, flesh changing color when wounded, becoming black or bluish-black.

"Ground under hemlock trees, Worcester, July.

"It resembles *L. piperatus* in general appearance. The whole plant turns black in drying.

"A large form of this species was found growing under hemlock trees at Gansevoort. The pileus was 4–8 inches (10–20 centimeters) broad, at first white or whitish, umbilicate or centrally depressed; then more or less stained with smoky-brown or blackish hues and subinfundibuliform. The flesh is white and taste mild; the stem is short, 1–2 inches (2.5–5 centimeters) thick, solid, white, and somewhat pruinose; the gills are distant, unequal, very brittle, tinged with yellow. Every part of the plant turns blackish or violaceous black where wounded. By this character it is distinguished from *R. nigricans,* in which the flesh at first becomes red where broken." 41st Rep. Peck. Found also in Ohio by Professor Morgan, under beech trees in hilly woods.

5. "R. COMPACTA, Peck, 32d Rep. N. Y. State Mus. Nat. Hist., 1879, p. 32. Pileus white, firm, solid, cracked in age, sometimes tinged with

red or yellow or both in spots, turning up in age, seldom depressed; lamellae very white, almost free, not forked or dimidiate, becoming brown when bruised or dry; stem solid, white, even, smooth; flesh at first white, then brownish."—Frost.

"Pileus 3–5 inches (7.5–12.5 centimeters) broad, fleshy, compact, convex or centrally depressed, whitish, sometimes tinged with red or yellow, becoming reddish-alutinaceous or dingy-ochraceous with age, the margin thin, even, incurved when young. Gills rather broad, subdistant, nearly free, some of them forked, a few dimidiate, white, becoming brown with age or where bruised. Stem 2–4 inches (5–10 centimeters) long, ⅝–1 inch (16–24^{mm}) thick, short, equal, firm, solid, white, changing color like the pileus; spores subglobose, nearly even, .00035 inch (9μ) in diameter.

"Open woods. Sandlake and Brewerton. August and September.

"The late Mr. C. C. Frost sent me specimens and manuscript descriptions of a few species of fungi collected by him in Vermont. He gave names to those which he considered new species, and it gives me pleasure to adopt his names whenever it is rendered possible by the discovery of the species within our limits. The plant here described does not fully agree with his manuscript description, which I have quoted, but it approaches so near an agreement that there can not be much doubt of the specific identity of the two plants. In our plant the pileus is sometimes split on the margin. The change in the color of the pileus and stem is nearly the same, but the lamellae sometimes becomes darker than either. When drying, the specimens emit a strong and very disagreeable odor."—Peck. Massachusetts, Frost.

II. FURCATÆ.

6. "R. OLIVASCENS, Fr. Hym. Eur., p. 441; Sacc. Syll., p. 456. Pileus everywhere fleshy, expanded, umbilicate, *olivaceous*, the *disk becoming yellow*, margin even. Stem firm, even, pure white. Gills attenuated behind, crowded, almost equal, *white, becoming yellowish.* In frondose groves. This noble species should from its habit be placed among the *Furcatæ*, but the gills are more rarely forked and their form approaches that of the *Fragiles.* In several respects it agrees with the *Compactæ.*"—Fr.

Spores ochraceous. 8–10 by 6–8μ. Sacc. Syll. New York, in woods.

7. "R. FURCATA, (Pers.) Fr. Hym. Eur., p. 441; Stev., B. F., p. 116; Sacc. Syll., p. 456. Pileus about 3 inches (7.5 centimeters) broad, sometimes æruginous-greenish, sometimes umber-greenish, fleshy, compact, gibbous, then plano-depressed or infundibuliform, *even,* smooth, but often *sprinkled with slightly silky luster*, pellicle here and there separable, margin thin, at first inflexed, then spreading, always *even;* flesh firm, somewhat cheesy, white. Stem 2 inches (5 centimeters) or a little more long, solid, firm, equal or attenuated downwards, even, white. Gills *adnate-decurrent, rather thick,* somewhat distant but broad, attenuated

at both ends, frequently forked, shining white. Spores globose, echinulate, 6–7μ. C. B. P. Name, *furca*, a fork. With forked gills. (Fr. Monogr. ii. p. 187; Berk. Out. p. 210; C. Hbk. n. 616; S. Mycol. Scot. n. 586; Ag. Pers. Krombh. t. 62. f. I, 2, t, 69. f. 18–22; Bull. t. 26; Schaeff. t. 94; f. I. Barla t. 16, f. 1–9; Harz. t. 54, t. 63, f. 5; Paul. t. 74. f. 1; Buxb. C. v. t. 47, f. 2.")—Stevenson.

Taste, bitterish saline. This species has been considered poisonous, but later researches indicate that it is probably harmless. North Carolina and Pennsylvania common in grassy woods, Schweinitz; North Carolina, Curtis; Massachusetts, Frost; Minnesota, common in woods, September, Johnson; Wisconsin, Bundy; New Jersey, Ellis; Ohio, common, Morgan.

8. "R. SANGUINEA, (Bull.) Fr. Hym. Eur., p. 442; Stev., B. F., p. 116; Cooke, Ill., 1019; Sacc. Syll., p. 457. Pileus 2–3 inches (5–7.5 centimeters) broad, blood-red or becoming pale round the *even*, spreading, *acute margin*, fleshy, firm, at first convex obtuse, then depressed and infundibuliform and commonly globose in the center, polished, even, *moist* in damp weather; flesh firm, cheesy, white. Stem stout, spongy-stuffed, at first contracted at the apex, then equal slightly striate, white or reddish. Gills at first adnate, then truly decurrent, very crowded, very narrow, connected by veins, fragile, somewhat forked, shining white. Taste, *acrid*, peppery. Often confounded with *R. rubra*, which is of the same color, but entirely different from it in the firm, solid flesh, in the gills being adnate, then deeply decurrent, and acuminate in front. In woods, chiefly fir. Uncommon. August, September. Poisonous. Name, *sanguis*, blood. Blood-colored." (Fr. Monogr., ii, p. 188; Berk. Out., p. 210; C. Hbk. n. 617; S. Mycol. Scot. n. 587; Ag. Bull., t. 42.)

Minnesota, in woods, July, Johnson; Wisconsin, Bundy; California, Harkness & Moore; Nova Scotia, in pine woods, September, Somers.

9. "R. ROSACEA, Fr. Hym. Eur., p. 442; Stev., B. F., p. 117; Cooke, Ill., 1020; Sacc. Syll., p. 457. Pileus 2–4 inches (5–10 centimeters) broad, somewhat flesh-colored, varying in intensity, becoming whitish when the pellicle disappears, often *variegated with darker spots when dry*, compactly fleshy, at first convex, then expanded, obtuse, commonly *unequal*, repand, evenly incised, covered with a pellicle which is *viscid* and separable in wet weather, *margin acute*, even; flesh firm, cheesy, white. Stem about 2 inches (5 centimeters) long, solid, firm, at length spongy internally, even, smooth, occasionally ventricose, white or reddish. Gills in every stage of growth adnate, thin, crowded, fragile, forked behind, with dimidiate ones intermixed, always persistently white. Spores papillose, 7μ (W. G. S.). Name, *rosa*, a rose; rose-colored. (Fr. Monogr. ii, p. 188; Berk. Out., p. 210; C. Hbk., n. 618; S. Mycol. Scot., n. 588; Ag. Bull., t. 509, f. z.")—Stevenson.

Taste *slowly* acrid. Allied to R. *sanguinea*, but irregular, often eccentric, with the pileus somewhat repand, *scarcely depressed*, and the

gills less crowded, broader, less divided, *scarcely* connected. In mixed woods. Frequent. September, October.

Minnesota, July, Johnson; Rhode Island, Bennett.

10. "R. SARDONIA, Fr. Hym. Eur., p. 442; Stev., B. F., p. 117; Sacc. Syll., p. 458. Pileus 2–3 inches (5–7.5 centimeters) broad, reddish, etc., fleshy, compact, convex, then plane, rarely depressed, but here and there repand, with an adnate pellicle, which is viscid in wet weather, and soon changes color, and then often spotted, ***margin even.*** Stem 1½–2 inches (4–5 centimeters) long, almost 1 inch (2.5 centimeters) thick, solid, firm, but at length spongy within, even, white, or reddish. Gills adnate, *crowded*, broad, somewhat forked, *white*, exuding watery drops in wet weather, whence arise *yellowish* spots when dry. Robust, firm. The color is very changeable, sometimes reddish, sometimes pallid with yellow spots, sometimes dingy yellow, opaque. Flesh same as in *R. rosacea*, etc. Intermediate between *R. rosacea* and *R. expallens*, but distinct from both in color, becoming yellow.

"In woods, chiefly fir. Uncommon. September.

"Name—from its acrid taste—*Herba sardonia* (probably *Ranunculus sceleratus*), screwing the mouth with its bitterness. (Fr. Monogr. i. p. 189; Berk. Out. p. 211; C. Hbk. n. 619; S. Mycol. Scot., n. 589; Ag. Krombh. t. 68, f. 1–4; Schaeff. t. 16, f. 5, 6.") Stevenson.

Spores, 8–10 by 8μ. Sacc. Syll. Minnesota, July, Johnson; Wisconsin, Bundy.

11. "R. DEPALLENS, (Pers.) Fr. Hym. Eur., p. 442; Stev., B. F., p. 117; Cooke, Ill., 1021; Sacc. Syll., p. 458. Pileus pallid reddish or inclining to fuscous, etc., fleshy, firm, convex, then plane, more rarely depressed, but commonly *irregularly shaped and undulated*, even, the thin adnate pellicle presently changing color, especially at the disk, the spreading margin even, but slightly striate when old; flesh white. Stem about 1½ inches (4 centimeters) long, solid, firm, commonly attenuated downwards, *white, becoming cinereous* when old. Gills adnexed, broad, crowded, distinct, but commonly forked at the base, often with shorter ones intermixed. Inodorous, taste mild. The color of the pileus is at first pallid reddish, or inclining to fuscous, then whitish or yellowish, opaque in every stage of growth. It approaches nearest to the *Heterophyllæ*.

In beech woods, pastures, etc. Uncommon. August–September.

Name—*de*, and *palleo*, to be pale. Becoming pale. (Fr. Monogr. ii. p. 189; Berk. Out. p. 211; C. Hbk. n. 620; S. Mycol. Scot. n. 590; Krombh. t. 66, f. 12, 13.") Stevenson.

Edible. North Carolina and Pennsylvania, in pine woods, Schweinitz; North Carolina, in pine woods, Curtis; Minnesota, in thin woods, July Johnson; Wisconsin, Bundy; Nova Scotia, under spruce, Somers.

(*To be continued.*)

NEW WESTERN FUNGI.

By J. B. Ellis and B. T. Galloway.

Phoma thermopsidis, *n. s.* On dead stems of *Thermopsis rhombifolia.* Helena, Mont. Summer of 1888, F. D. Kelsey, Com. F. W. Anderson, No. 413. Perithecia gregarious, subcuticular raising and rupturing the epidermis, but hardly erumpent, subhemispheric with papilliform ostiolum. Sporules oblong-hyaline 2-nucleate, not curved, 15–20 by 5–6μ.

Phleospora oxytropidis, *n. s.* On *Oxytropis Lamberti.* Great Falls, Montana, June, 1888. F. W. Anderson, No. 258. Perithecia amphigenous, innate-erumpent, about 200μ in diameter, scattered, black. Sporules cylindrical or ovoid, 40–50 by 3½–4½μ., hyaline, straight, obtuse, nucleate, issuing in a whitish mass.

Pestalozziella Andersoni, *n. s.* On living leaves of *Asclepias* or *Apocynum.* Sand Coulee, Mont. September, 1888. F. W. Anderson, No. 289, Acervuli amphigenous, thickly scattered over the leaf, black, erumpent, discoid, 150–200μ in diameter. Sporules ovate-elliptical, subacute, hyaline, continuous, 15–22 by 7–10μ, with an irregularly branched hyaline, 3–4-parted crest of spreading bristles or hairs 12–15μ long, much as in *Pestalozziella subsessilis*, S. & E. The basidia also are obscure or wanting, as in that species. The affected leaves turn yellow and then brown.

Dicoccum lathyrinum, *n. s.* On living leaves of *Lathyrus ochroleucus*, Highwood Cañon, in the Highwood Mountains, Montana, Leg. R. S. Williamson, Com. F. W. Anderson, No. 301. Conidia oblong, 1-septate, slightly constricted, straight, olivaceous, granular, 20–22 by 7–8μ, forming small, subconfluent, chestnut-colored, velutinous patches on the under side of the leaves (2–3^{mm} in extent), limited by the veinlets, not on any definite spot, but causing the leaf to turn slightly yellowish above. There is no appreciable mycelium, at least on the surface of the leaf.

Peziza yogoensis, *n. s.* On dead leaves of *Carex.* Yogo, in the Belt Mountains, Montana, July, Leg. 1888, R. S. Williamson, Com. F. W. Anderson, No. 317. Erumpent of fibrous texture, 200μ in diameter, margin fimbriate and incurved, substance of the perithecia olivaceous. Disk pale, asci oblong, 55–60 by 15–18μ, sessile, paraphyses stout, about equal to the asci; not abundant. Sporidia oblique or biseriate, oblong, 2-nucleate, hyaline, rounded at the ends and a little narrower at one end, not curved, 13–15 by 4–5μ.

On the same leaves is a *Sphærella*, with gregarious perithecia, oblong, inequilateral, 35 by 12μ, sessile asci, and crowded biseriate, oblong 12-15 by 3½–4μ, sporidia. Very near *S. Wichuriana*, Schrœt.

Epicoccum rubripes, *n. s.* On dead herbaceous stems, Montana. Anderson, No. 290. Sporodochia gregarious, hemispheric, black, ¼–½^{mm}

in diameter, covered above with a layer of obovate, subolivaceous, roughish, substipitate conidia, 7–15μ in diameter, substance of the inner and lower part of the sporodochia rose-red.

The general appearance is that of some erumpent *Sphæria.*

SPHÆRELLA AQUILEGIÆ, *n. s.* On *Aquilegia Jonesii*, Yogo, in the Belt Mountains, Helena, Montana. July, 1888, Leg. R. S. Williamson, Com. F. W. Anderson, No. 299.

Perithecia scattered on the leaves and petioles, erumpent, rather acutely hemispherical, black, 100–120μ. in diameter, pierced above, and more or less distinctly fringed at base with brown creeping threads, texture coarsely cellular. Asci obovate-oblong, sessile, 50–60 by 22–25μ, inequilateral, without paraphyses. Sporidia crowded-biseriate, subclavate-oblong, hyaline, straight, obtuse, slightly constricted, 20–22 by 9–11μ, each cell 1–3-nucleate. Differs from *S. pachyasca*, Rostrop, which is also found in Montana on *Phlox cæspitosa*, principally in its broader sporidia. Perhaps this might be considered a form of that species.

PLEOSPORA LAXA, *n. s.* On dead leaves and culms of some grasses. Montana, Anderson, No. 348. Perithecia scattered, subglobose, black 150–170μ. in diameter, their bases projecting on one side of the lamina of the leaf and their apices on the other. Asci few (6–8), in a perithecium, inflated-oblong, broadly rounded above, and contracted at the base into a short stipe, 150–200 by 35–55μ. Paraphyses obscure. Sporidia 8, in an ascus, obovate, oblong, 6–8-septate, coarsely muriform, deeply constricted near the middle, so as easily to break in two at the constriction, straw-yellow, 35–45 by 15–20μ (mostly 15μ wide). This seems to differ from any of the other described species on grasses or *Carices* in its strongly constricted spores. This character is very distinct through all stages of growth.

The constriction is generally at the third septum from the upper end of the spore, the part above this constriction being broader and shorter (often nearly globose) than the part below it. This comes near *P. Islandica*, Johans, but differs in its more obtuse and deeply constricted sporidia.

LEPTOSPHÆRIA SPOROBOLI, *n. s.* On dead culms of *Sporobolus depauperatus*, Sand Coulee, Cascade County, Mont., August, 1887. F. W. Anderson, No. 233.

Perithecia scattered, erumpent-superficial subhemispherical, nearly smooth, black, $\frac{1}{5}$–$\frac{1}{4}$^{mm} in diameter, with a short, thick, nipple-like ostiolum. Asci clavate-cylindrical 75–80 by 16–18μ, with abundant paraphyses. Sporidia crowded-biseriate, overlapping each other, oblong-fusoid, ends subobtuse, straight, 6-septate, and not at all or finally slightly constricted at the septa, about 22 by 7μ, straight or nearly so. Differs from *L. culmifraga*, to which it is closely allied in its shorter and quite constantly only 6-septate sporidia, and from *L. culmicola* in its superficial growth.

DIDYMOSPHÆRIA EURYASCA, *n. s.* On dead leaves of *Pinus Murrayana.* Summit of Mt. Helena, Lewis and Clarke County, Mont. September, 1887. F. W. Anderson, No. 403. Perithecia scattered, suberumpent, minute 80–100μ, perforated above. Asci inequilaterally ovate, sessile, 35–40 by 12–15μ. Paraphyses? Sporidia bi-triseriate ovate-oblong, 1-septate, constricted, rounded at the ends, brown, 12–15 by 3½–5μ. The perithecia are only partially erumpent, remaining partly covered by the epidermis.

PUCCINIA MUTABILIS, *n. s.* II and III. On *Allium mutabile,* Sand Coulee, Mont., June, 1888. Anderson, No. 446. Sori suborbicular or elliptical, small, ½^{mm} in diameter, covered at first by the epidermis, soon exposed and chestnut-brown, sometimes more or less confluent. Uredospores, pale, faintly aculeolate, globose or elliptical 18–22 by 15μ. Teleutospores, ovate or elliptical obtuse and rounded, and moderately thickened above, distinctly constricted, narrowed below (in the ovate form) into the rather stout hyaline pedicel, which is a little shorter than or about as long as the spore. This differs from *P. alliorum,* Cda., *P. porri,* (Sow.) Winter, and *P. scillæ,* Linhart, in its shorter, obtuse spores.

SPORIDESMIUM MACROSPOROIDES, *n. s.* On stems of *Artemisia tridentata.* Glendale, Mont., October, 1888. F. W. Anderson, No. 391. Forming orbicular or subelongated disks 1–3^{mm} in diameter, at first covered by the white tomentose coating of the stem, then bare and black, appearing as a slightly elevated disk or flattened tubercle, the lower stratum of which is composed of the closely compacted hyphæ changed into a subgrumous mass and giving rise to a superficial layer of conidia which are at first oval or subglobose and subhyaline, but soon become dark and 1-septate or oftener sarcinuliform, *i. e.,* subglobose 8–12μ in diameter, and divided into 4 cells by two septa at right angles to each other. These 4-celled conidia soon increase in size by the formation of additional cells till they finally simulate more or less perfectly the form of the conidia of *Macrosporium,* clavate or obovate with 3–4 transverse septa and one or more longitudinal septa forming an olive brown conidium 30–40 by 18–20μ, without any distinct pedicel. Var. *gummosum,* on twigs of *Betula alnifolia* (Anderson, 294), is preceded by a gummy exudation in the form of a small transparent globule and has the conidia more irregular in shape.

SEPTOSPORIUM HETEROSPORUM, *n. s.* On living leaves of *Vitis Californica,* near Orange, Cal. Prof. F. L. Scribner, October, 1887. Spots scattered and more or less confluent, indefinitely limited, rusty brown above, ½ to 1 centimeter in diameter, smoky black below or appearing gray on account of the tomentum of the leaf.

Hyphæ hypophyllous, issuing in fascicles from the stomata of the leaf and bearing at their apices the very variable conidia, which are at first oblong-cylindrical, 2–3 septate, 20–40 by 5–7μ, like the conidia of a *Cercospora.* These conidia soon become constricted at the septa and each of the three or four cells become uniseptate. The three primary septa

gradually become deeper until the conidia finally separate into three or four separate uniseptate segments of a short elliptical or nearly spherical shape, about 12μ in diameter, with the epispore distinctly roughened. We have compared this with specimens of *Septosporium Fuckelii*, Thüm., as represented in de Thümen's Mycotheca Universalis, 671, and with specimens collected in Algeria by Professor Viala. The California specimens differ in their much shorter hyphæ and very different conidia, which are much constricted at the septa. Plate X, Figs. 5 and 6.

NEW SPECIES OF HYPHOMYCETOUS FUNGI.

By J. B. Ellis and Benjamin M. Everhart.

Oidium pirinum, *n. s.* On leaves of *Pirus coronaria*, Racine, Wis., June, 1888. Dr. J. J. Davis, No. 31. Spots large, occupying a large part of the leaf, light brown, with definite, rather irregular outline, finally spreading over and killing the entire leaf. Conidia subglobose, with the surface slightly uneven, hyaline 12–16μ in diameter, closely concatenate in series of 3–4, the lower one supported on a slender basidium 10–12μ long. A portion of this basidium remains attached to the lower conidium as a short pedicel. The prostrate sterile hyphæ are either wanting or at least not conspicuous, the abundant pulverulent, light-cinereous conidia, which are mostly on the upper surface of the leaf, being the most conspicuous feature.

Ovularia compacta, *n. s.* On living leaves of *Macrorhyncus troximoides.* Wet mountain valley, Colorado, July, 1888. Demetrio, 182. Spots amphigenous, subelliptical, 1^{cm} in diameter, light brown or buff. Hyphæ simple, continuous, 15–25 by 4μ, slightly toothed above or entire, forming dense tufts and bearing at their tips the ovate 12–15 by 5–6μ conidia.

Langloisula. A new genus of *Mucedineæ.*

Hyphæ prostrate, much branched and interwoven, forming a loose, submembranaceous layer, and bearing the large solitary conidia at their extremities. Differs from *Monosporium* in the absence of any erect fertile hyphæ and from *Monilia* in its solitary conidia.

Langloisula spinosa, *n. s.* Growing around the base of the culms of *Andropogon muricatum* (in gardens). St. Martinville, La., January, 1889. Langlois, 1641.

Forms a thin, light-yellow layer like a *Corticium*, finally becoming of a deeper color (tawny-yellow) and subpulverulent, breaking up into frustules like *Corticium scutellare* B. & C., and falling off. The fungus is made up of prostrate yellow hyphæ 2–3μ in diameter, repeatedly dichotomously branched; the ultimate branches short, subulate or spiniform, bearing the globose or oval yellow conidia 12–14μ in diameter in a loose layer partially covering the subjacent hyphæ. The ultimate

branching of the threads reminds one of the sporophores of some of the *Peronosporeæ*. The general appearance is exactly that of a thin yellow *Corticium* like N. A. F. 657 ("*Gonytrichum fulvum*"), which we now think is only an imperfectly developed state of *Corticium cervicolor*, B. & C., being in fact only the lower sterile stratum of that species. The conidia in the Louisiana fungus resemble those of a *Monilia* in having a short appendage resembling the connecting cell between the spores in that genus, but we can not make out that the conidia are concatenate, the short appendage being rather of the nature of a pedicel. Plate X, Figs. 1 and 2.

RAMULARIA BRUNELLÆ, *n. s.* On living leaves of *Brunella vulgaris*. Racine, Wis., August, 1888. Dr. J. J. Davis, No. 9. Spots large, dark brown, more or less distinctly concentrically zoned above, rather indefinitely limited, more or less confluent so as often to cover nearly the entire leaf. Hyphæ hypophyllous, short, 10–15 by $2\frac{1}{2}\mu$, hyaline, mostly toothed above, forming minute white scattered tufts, scarcely visible. Conidia oblong-cylindrical, continuous, 10–15 by $1\frac{1}{2}$–$3\ \mu$.

RAMULARIA SEROTINA, *n. s.* On leaves of *Solidago serotina*. Lake County, Ill., July, 1888. Dr. J. J. Davis, No. 39. Spots amphigenous, 1–5^{mm} (mostly 2–3^{mm}), pale yellow-brown, with a narrow, definite, darker margin; sometimes confluent (1^{cm} or more), of somewhat irregular shape, but the smaller ones suborbicular. Hyphæ amphigenous, fasciculate subnodulose, and toothed above, continuous or faintly 1–2-septate, hyaline, 25–30 by 3μ. Conidia oblong-cylindrical, hyaline, 1-septate, 15–28 by 3μ, subconcatenate. On account of the definite spots and quite constantly 1-septate conidia this is different, from *R. virgaurea*, Thüm., which pertains to *Cercospora*, often having the conidia 50–75μ long.

RAMULARIA VIBURNI, *n. s.* On living leaves of *Viburnum lentago*. Racine, Wis., June, 1888. Dr. J. J. Davis, No. 27. Spots amphigenous, rusty brown (greenish-brown at first) 4–5μ in diameter, suborbicular, with a darker margin. Hyphæ amphigenous 12–20 by $2\frac{1}{2}$–3μ, hyaline, tufts erect, simple. Conidia fusoid-cylindrical, slightly curved, 1–3 septate, 20–40 by $1\frac{1}{2}$–2μ, yellowish-hyaline. Resembles *R. andromedæ*, E. & M., but is amphigenous, and the conidia are longer and have a greater number of septa.

CONIOSPORIUM CORTICALE, *n. s.* In bark of maple logs, London, Canada. Prof. J. Dearness, No. 2. Forms a brownish-black dusty stratum between the lamina of the bark. Conidia globose 3–4μ in diameter or elliptical or ovate-elliptical $4\frac{1}{2}$–5 by 3–4μ. The globose conidia comparatively few. This must come near *C. aterrimum*, Cda., but we think it different, though we have no specimen of that species.

FUSICLADIUM BREVIPUS, *n. s.* On leaves of *Astragalus hypoglottis*. Musie Pass, Sangre de Christo Range, Colorado, July, 1888. Demetrio, 199. Hypophyllous, forming small, scattered or subconfluent mouse-colored or smoky olivaceous patches scattered over the lower face of the leaf. Hyphæ, consisting of collections of subovate, brownish cells

8–12 by 5–7μ, from the tops of which arise the elliptical or oblong 25–55 by 8–11μ conidia, of an olivaceous brown color, at first continuous, then 1–2 septate, the longer ones attenuated below into a stipe like base. Approaches *Cercospora.*

CLASTERISPORIUM CÆSPITULOSUM, *n. s.* On rotten maple wood. Newfield, N. J., 1879. Conida fusoid-cylindrical, 12–20 septate, 100–120 by 12–15μ, subattenuated above, but with the apex distinctly rounded; abruptly contracted below, with a short stipe-like base attached directly to the wood without any perceptible prostrate threads. The conidia are nearly opaque, straight and erect, not constricted at the septa, but some of them are contracted near the middle. They grow in loose fascicles, which are more or less crowded, forming black tomentose patches or subeffused. Nearly allied to *C. larvatum*, C. & E., but differs in its *straight* conidia with short stipitate base.

HETEROSPORIUM HYBRIDUM, *n. s.* On dead stems of *Cleome integrifolia.* Helena, Mont., August, 1888. Rev. F. D. Kelsey, No. 137. Subcuticular, then erumpent, forming grayish-olive oblong, velutinous patches (2–3 by 1–2^{mm}), or by confluence 1^{cm} or more. Hyphæ erect, simple or sparingly branched; septate 100μ long or over, and 5–7μ thick. Conidia elliptical or oblong-elliptical, 1–2 septate (mostly only 1 septate), minutely hispid, slightly constricted at the septum. There are also regular Macrosporium conidia (apparently arising from the same hyphæ), clavate-obovate, pedicellate, about 4 septate, 15–50 by 10–15μ, the longer ones muriform. From its ambiguous character this is an unsatisfactory thing.

HETEROSPORIUM FUNGICOLUM, *n. s.* On old *Polyporus picipes.* Lincoln, Nebr. H. J. Webber. Olivaceous. Hyphæ 115–150 by 5–6μ, abruptly bent and crooked above, bearing laterally and terminally the oblong elliptical yellowish-brown 1–3-septate, minutely echinulate, 12–25 by 7–12μ conidia.

CERCOSPORA SYMPHORICARPI, *n. s.* On *Symphoricarpus vulgaris.* Rooks County, Kans. Mr. E. Bartholomew, 227 B. Hypophyllous, on small (1–2^{mm}), deep rust-colored round spots. Hyphæ fasciculate 30–40 by 3μ, continuous, brownish, denticulate above. Conidia clavate-oblong 20–30 by 3 μ; 1–3 septate.

CERCOSPORA VIRIDULA, *n. s.* On leaves of *Ipomea purpurea.* (Convolvulus.) Concordia, Mo., October, 1888. Rev. C. H. Demetrio, 214. Spots suborbicular ($\frac{1}{2}$–$\frac{3}{4}^{cm}$), rather indefinitely margined, dirty brown above, paler and greenish-brown below. Hyphæ epiphyllous, 25–35 by 4μ, pale brown, continuous, shouldered above, rising in small fascicles from a scanty tubercular base, thickly scattered on the spots, but inconspicuous. Conidia subcylindrical but narrowed above, subhyaline, 6–8-septate, 70–80 by 4μ. Differs from *C. ipomœæ*, Winter, in its more indefinite and larger spots and shorter conidia.

CERCOSPORA DUPLICATA, *n. s.* On large (4–6^{cm}) dark, dirty brown, irregular shaped spots on leaves of *Tecoma radicans.* St. Martinville, La., October, 1888. Langlois, 1549. Hyphæ epiphyllous, very short

(8–10μ), on a small (30–35μ) tubercular base, bearing at their apices the linear-lanceolate, subhyaline, faintly 3–6-septate 30–60 by 2½–3μ conidia. The spots are at first of a reddish-purple tint. This is entirely different from *C. sordida*, Sacc., an olivaceous effused species which was observed on the under side of the same leaves.

CERCOSPORA DOLICHI, *n. s.* On leaves of *Dolichos sinensis.* Starkville, Miss., September, 1888. Prof. S. M. Tracy. Amphigenous, but more abundant below. Hyphæ short 20–25 (exceptionally 30–35) by 4–5μ, olivaceous, entire or slightly toothed above, continuous or with one or two obscure septa, forming small but close tufts without any distinct tubercular base, the tufts scattered over almost the entire surface of the leaf both on the reddish spots and on the green parts of the leaf, but unevenly distributed, so as to present a clouded or mottled appearance. Conidia slender obclavate, hyaline, 3–5 or more septate, 50–100 by 3½–4. The spots are much like those of *Amerosporium œconomicum*, E. & T. (J. M. IV. p. 102), only not white, but rusty-red, or at most only whitish.

CERCOSPORA SII, *n. s.* On leaves of *Sium cicutæfolium*. Racine, Wis., September, 1888. Dr. J. J. Davis, No. 62. Mostly hypophyllous, in small (2–3^{mm}) but dense patches, but finally confluent, so as often to cover nearly the entire surface of the leaf, which is more or less mottled and stained yellowish, black above. Hyphæ loosely fasciculate, smoky, or olivaceous-hyaline, 40–60 by 5μ, strongly shouldered and toothed above, continuous or sparingly septate. Conidia lateral and terminal, oblong-cylindrical, mostly 1-septate, very slightly curved, granular, 20–45 by 5–7μ (mostly 30–40 by 6–7μ).

CERCOSPORA AGERATOIDES, *n. s.* On living leaves of *Eupatorium ageratoides*. Newfield, N. J., July to September, 1885. Hypophyllous. Tufts effused, forming olivaceous, velvety patches 1–3^{mm} in diameter, subangular and bounded by the veinlets of the leaf, finally confluent and nearly tobacco-brown. Hyphæ in minute tufts of 5–8 together, simple, septate, brown, subundulate above 50–90 by 4μ. Conidia cylindrical or lanceolate, 40–75 by 3½–5μ, 4–6 septate, pale olivaceous. Closely allied to *C. clavata*, Ger. The color and habit are much the same but besides the different host plant, this has the hyphæ longer and in tufts less dense, and the conidia, though of the same general character, not as variable in length and mostly narrower. On the same leaves are light colored subangular spots, also limited by the veinlets of the leaf, but they do not produce the *Cercospora*. In a var. of this (?) on *E. album*, the light-colored spots are wanting, the hyphæ mostly shorter (40μ.) and the conidia rather longer (70–80μ) and narrower (3μ).

CERCOSPORA PERFOLIATA, *n. s.* On living leaves of *Eupatorium perfoliatum*. Racine, Wis., September, 1888. Dr. J. J. Davis, No. 64. Hypophyllous. Hyphæ decumbent, with their free ends ascending, 30–40 by 4–5μ, nucleate, continuous, brownish, subentire and obtuse above, effused in suborbicular brown patches, not definitely lim-

ited and finally more or less confluent. The leaf is marked above with yellowish blotches, which finally become dark brown. Conidia *oblong*, pale tobacco-brown, nucleate becoming 1–septate, 20–35 by 5–6μ. The mode of growth is like that of *C. clavata*, Ger. Both this and *C. ageratoides*, E. & E., differ from *C. eupatorii*, Pk., which is on definite spots.

CERCOSPORA SIDÆCOLA, *n. s.* On living leaves of *Sida spinosa* St. Martinville, La., December, 1888. Rev. A. B. Langlois, No. 1555. Forming smoky black indefinitely effused velutinous patches on the under side of the leaf, the upper side remaining green or only slightly discolored. Hyphæ scarcely tufted, simple, multiseptate, reddish-brown (under the microscope), repeatedly shouldered above, slender, 150–225 by about 4μ. Conidia slender, obclavate, hyaline, granular and nucleate, becoming faintly 5–7–septate, 70–100 by 4–5μ.

CERCOSPORA FUSCO-VIRENS, Sacc. Prof. S. M. Tracy finds this at Madison, Miss., on *Passiflora incarnata* with hyphæ 40–50 by 4–5μ. Conidia 80–120 by 3–4μ. Are the measurements in Sylloge transposed? It would appear so from these specimens, which agree otherwise with Saccardo's description.

SPORIDESMIUM INSULARE, *n. s.* On bark of living oak. Flatbush, L. I., N. Y., December, 1888. Rev. J. L. Zabriskie, 52. Forming small, black, scattered patches, about as large as a pin-head, or more or less confluent, bursting through the sterile, granular thallus of some lichen. Conidia arising from slender, subhyaline inconspicuous creeping threads, at first globose, and as in *S. sarcinula*, B. & C., marked by two septa at right angles, soon enlarged by the addition of a margin of peripheric cells and becoming 12–15μ in diameter; when growing beyond this size they usually become oblong 25–40 by 15–20μ, more or less irregular in shape. The component cells are about 3μ in diameter. We have not seen *S. epicoccoides*, B. & C., from which possibly this is not distinct. The conidia under the microscope remind one of *Cheirospora botryospora*, Fr.

DENDRODOCHIUM NIGRESCENS, *n. s.* On bark of *Acer negundo*. Sand Coulee, Cascade County, Mont., November, 1888. F. W. Anderson. Sporodochia erumpent, about 1^{mm} across, flesh color, becoming nearly black. Basidia dichotomously or subverticillately branched, mostly curved. Conidia oblong, hyaline, 5–7 by $1\frac{1}{2}$–2μ.

NEW SPECIES OF FUNGI.

By W. A. KELLERMAN and W. T. SWINGLE.

SACIDIUM ULMI-GALLÆ, *n. s.* Spots none; pseudo-perithecia occupying indefinite blackened portions of the outside of the gall, rather few, subgregarious, indistinctly limited, black or dusky black, oval, elliptical or irregularly linear, $\frac{1}{2}$–2 by $\frac{1}{4}$–$\frac{1}{2}^{mm}$, at first irregularly inflated, then depressed and corrugated, very early splitting nearly the whole length

and finally exposing nearly the whole hymeneal layer by the free edges approaching the sides in a compact roll; formed from the blackened and slightly changed cuticle of the host; on the upper surface granulate, below irregularly tuberculate, not distinctly cellular; basidia hyaline, clavate, cylindrical or somewhat irregular, continuous or sometimes apparently sparingly septate, very numerous, densely crowded, 15–25 by 2–4μ; sporules hyaline, ovate, clavate, cylindrical or sometimes oblong or oval, attached by the smaller end, bluntly rounded at both ends, often slightly inequilateral, 7½–11 by 3–5μ, mostly 8–10 by 3½–4½μ, wall very thin, smooth, contents minutely many-guttulate, especially at the ends. On galls caused by some species of *Phytoptus* on the upper side of the leaves of *Ulmus Americana*, Manhattan, Kans., May and June, 1889. (No. 1493.) The basidia of this species are formed between the epidermal cells and the cuticle in almost exactly the same way as in some species of *Taphrina*. The mycelium is formed, chiefly between the cells, for a considerable distance from the perithecia. It is hyaline, many septate, rather coarse, and often much twisted and contorted. This species differs from most of the *Sacidii* in having, apparently, no true perithecium. However, the related genus *Leptothyrum* has such species.

The galls which it attacks are not those caused by *Phytoptus ulmi*. They are much larger and differ in shape from the galls caused by that species. They are "nail galls" about 5–10 by 2–4^{mm}, usually acute or subacute at the top and abruptly narrowed and nearly closed at the base The sides are usually more or less angled or ribbed; often several galls become attached to each other or spring from a common base without becoming attached above.

CYLINDROSPORIUM TRIOSTEI, *n. s.* Spots indefinite, amphigenous but more prominent above, yellowish green, at first small (½–2^{mm} in diameter), sometimes at length becoming confluent and from 2–5^{mm} in diameter. Usually sparse, scattered irregularly all over the leaf; acervuli, amphigenous, but often larger and more numerous below, sparse, at first subepidermal then erumpent, about 150–300μ in diameter, pale yellowish white; hyphae pallid, abundant, rather irregularly and sparingly branched, variable in diameter, often larger above, about 15–30 by 3–5μ, arising from a dense pseudo-parenchymatous mass of hyphae which at first issue through the stomata but soon force themselves through the epidermis all around finally pushing it away; conidia terminal on the hyphae or branches, subpersistent, abundant, in mass of a pale cream color, when seen singly subhyaline, elongate-fusoid, very strongly and regularly curved or rarely only slightly curved, ends rather obtuse or sometimes acute, the free end being the most acute, 3–7 (mostly 4–6) septate, not constricted at septa, rather regular in size, 35–67 by 4–6μ, mostly 45–57 by 4–5μ. Very rare on leaves of *Triosteum perfoliatum*. Manhattan, Kans., August 24, 1887. This species seems to be extremely rare, a few specimens were seen and conidia

sketched in 1886 but none were collected in any quantity till the following year. It is more abundant on the lower leaves but occurs also on the upper ones. The mycelium is very abundant, hyaline, somewhat branched and sparingly septate, about $2\frac{1}{2}$–$3\frac{1}{2}\mu$ in diameter. The conidia are often curved so as to form a semicircle and sometimes even still more curved; sometimes one end is more curved than the other. Owing to this fact of the conidia, and especially the longer ones, being so much curved they are in reality much longer than is shown by the measurements given.

CERCOSPORA AQUILEGIÆ, *n. s.* Spots distinct, about equally prominent on both sides of the leaflets, purplish brown, paler below, rather numerous, scattered over the leaf or sometimes confluent, variable in size, about 3–15^{mm} long and $1\frac{1}{2}$–5^{mm} wide, usually irregularly linear or oblong but sometimes nearly square when young, angular, often acutely pointed, limited by the veinlets; hyphæ sparsely scattered, dusky, simple, usually several septate, not at all or only slightly constricted at septa, tapering scarcely if at all or sometimes even slightly larger above, below nearly straight but towards the tip usually several times strongly geniculate and dentate, occasionally bent nearly at right angles, rather long, 50–145 by 4–$6\frac{1}{2}\mu$, mostly 80–110 by 5–6μ, often growing in small tufts which are composed of 2–6 loosely diverging hyphæ, and are scarcely noticeable except in section; conidia scarce, hyaline, more or less curved, flagellate, attached by the larger blunt end, the free end being very slender and acutely pointed, rather indistinctly multiseptate, scarcely or not at all constricted at septa, variable, often very long, 140–310μ long, $4\frac{1}{2}$–6μ in diameter at the base, and $1\frac{1}{2}$–3μ in diameter at the apex, mostly 150–250μ long, 5–6μ in diameter below, and 2–$2\frac{1}{2}\mu$ in diameter above. On radical leaves of *Aquilegia Canadensis*, Manhattan, Kans., June 21, 1889. (No. 1495.) This species is really distinguished from any published species occurring on *Ranunculaceæ* by its strongly bent hyphæ and very long conidia. The mycelium is sparse, hyaline, sparingly branched, sometimes guttate, 2–3μ in diameter. The conidia are sometimes rather variable in diameter towards the base, one or more of the segments being more slender than the adjoining ones.

CERCOSPORA GERANII, *n. s.* Spots visible on both sides of the leaf, brownish or dusky, oval or oblong or sometimes sublinear, often marginal or terminal sometimes limited by prominent veins, very often surrounded by a pale, but rather clear red coloration which is more prominent on the upper surface of the leaf and often involves more or less of the whole segment of the leaf especially the part beyond the spot and on the same side of the midvein, 2–8 by $1\frac{1}{2}$–4^{mm} mostly 3–7 by 2–3^{mm}; tufts amphigenous, but rather more abundant above, thickly and evenly scattered over the whole spot, rather small, deep seated, usually arising through stomata, composed of from 5–15 or even 20–30 hyphæ, which are densely packed below the surface, but considerably divergent above; hyphæ short and stout, dusky or brownish, 25–50μ

long, 3–4μ in diameter at base and 3–3½μ in diameter at apex, mostly about 30–40μ long, simple, sparingly septate at base, often somewhat bent at the tip and showing several closely proximate scars where conidia were attached; conidia abundant, persistent, hyaline, straight or slightly curved, cylindrical or, when very long, clavate, acute at both ends, attached by the larger end (?), plainly 1–5, mostly 3–4, septate, not constricted at septa, quite variable in size, and especially in width, 36–98μ long, 1¾–3μ in diameter at base and 1¼–3μ in diameter at apex, mostly 48–85μ long, 2¼–3μ in diameter at base and 1½–3μ in diameter at apex. On languishing lower leaves of *Geranium Carolinianum*, St. George, Pottawatomie County, May 30, 1887 (No. 898). The conidia in this species are remarkably abundant and persistent, and in good specimens may be seen attached to the hyphæ in such great numbers as to form a thin whitish coating over the spot. The tufts are quite variable in size and appear as minute black dots before the conidia are fully formed or after they have fallen. The mycelium is rather sparse, hyaline, rather regular in diameter (2½–3μ), but sparingly if at all septate.

CERCOSPORA GAURÆ, *n. s.* Spots amphigenous, definite, subolivaceous, surrounded by an indefinitely reddish coloration, suborbicular, oval, or rounded angular, about 5–10^{mm} in diameter, often limited by a vein on one side; tufts mostly epiphyllous but usually amphigenous, at first small, composed of few hyphæ, but becoming large (40–100μ in diameter), composed of hyphæ which are closely packed or slightly divergent; hyphæ short, simple, continuous, subfuscous, tapering slightly from the base, 15–30 by 2½–4μ, mostly 18–25 by 3–4μ; often dentate above, and sometimes bent or strongly dentate below; conidia of the same color as the hyphæ, slightly curved or straight, linear clavate, the larger attached ends subacute truncate, the free ends somewhat acute, when young nucleate, when mature 3–7 septate, 40–108 by 2–4μ, mostly 56–90 by 1½–3μ. On leaves of *Gaura biennis*, Columbus, Kans., July 12, 1887 (No. 1491). The nuclei in the young conidia appear to be in pairs on either side of the places where septa will appear.

CERCOSPORA LOBELIÆ, *n. s.* Spots visible on both sides of the leaf but more prominent above, light grayish or pallid dirty yellowish, at first minute, suborbicular then larger, 3–8^{mm} in diameter, oval or suborbicular, often subangular and sometimes irregular, surrounded by an indefinite dull purplish coloration, which is more pronounced around the smaller spots. Tufts scattered amphigenous but often more abundant below, composed of 10–20 or more laxly diverging hyphæ arising from an elevated polycellular, tubercular base; hyphæ clear fuligenous brown, less colored above, 50–135μ long; 5–7μ in diameter at base, and 2½–5μ in diameter at apex, mostly about 95–130μ long; 5–7μ in diameter at base, and 3½–4½μ in diameter at apex, above subgeniculate and showing at considerable intervals the old scars where conidia were attached, faintly several septate, not constricted at septa; conidia rather sparse,

hyaline, curved or more rarely straight, clavate or flagellate attached by the truncate base and above attenuate to a subacute point, somewhat faintly multiseptate, not constricted at septa, variable in size, 55–175μ long, 3–4½μ in diameter at base and 1–3μ in diameter at apex, mostly about 90–165μ long; 3–4μ in diameter at base, and 1½–2μ in diameter at apex. On leaves of *Lobelia syphilitica.* St. George, Pottawatomie County, Kans., September 29, 1888 (No. 1492). The mycelium of this species is rather abundant, hyaline, guttate, about 2–4μ in diameter, but often alternately inflated and contracted, sparingly branched and septate, but near the tubercular bases it becomes many septate, thick, and slightly colored. These bases when young are seen to be composed of the enlarged many-septate bases of the hyphæ, but when fully grown appear as a somewhat irregular mass of rather large cells. A few conidia were seen which had commenced to germinate.

This species is very different from *Cercospora effusa,* (B. & C.) E. & E., which sometimes occurs on the same leaves. It also seems distinct from *Cercospora ochracea,* Sacc. & Malbr., from which it differs, according to the description in Sacc. Syll., Vol. III, p. 447, No. 2151, in the character of the spots, the size of hyphæ and conidia, and color of conidia. Besides, that species occurs on *Lobelia urens* in Europe.

CERCOSPORA EUPHORBIÆ, *n. s.* Spots indefinite, merging gradually into the healthy leaf, dusky or sometimes almost black, but lighter (commonly cinereous dusky) in the center, occupying any portion or sometimes all of the leaf, suborbicular, ½–2^{cm} in diameter, commonly about 1^{cm}; tufts amphigenous but more abundant below, small, scarcely noticeable except in section, rather thickly scattered over the whole discolored area, but more abundant in the central portion, composed of from 3–15 (mostly 5–12) loosely diverging hyphæ which generally arise through stomata, though they have but a very short subepidermal portion; hyphæ dusky or brownish, cylindrical, tapering scarcely if at all, apparently having a round hole in the top, stout, simple, 60–120 by 4–7μ, mostly 75–110 by 5–6μ, sparingly septate, usually not constricted at septa, but sometimes very much so above, often sparingly subgeniculate or dentate from about the middle, usually showing but few marks of attachment of conidia; conidia rather abundant, hyaline, very stout and thick, clavate or cylindrical, straight or slightly curved, attached by the larger blunt end, free and somewhat acute, plainly 8–15-septate, not constricted at septa, usually somewhat granular within, very variable in size, 28–166μ long, 3–6μ in diameter at base and 1–5μ in diameter at apex, mostly 50–120 long, 4–5μ in diameter at base and 3–4μ in diameter at apex. On leaves of *Euphorbia corollata.* St. George, Pottawatomie County, Kans., August 13, 1888. (No. 1494.) This species is rather rare, but is usually abundant on such host plants as are attacked. It does not seem to have much preference for upper or lower leaves, but attacks any. The mycelium is hyaline, sparse, sparingly branched, and septate (?), guttate, rather regular in size, 2–4μ in diameter. The conidia are multiseptate even when small.

CERCOSPORA JUGLANDIS, *n. s.* Spots visible on both sides of the leaf, but more prominent above, brown, very small, $\frac{1}{5}$–1^{mm} in diameter, angular, limited by the veinlets and often occupying only a single one of the minute spaces inclosed by the veinlets, often by confluence forming large angular, brown or cinereous brown areas $\frac{1}{2}$–2^{cm} in diameter, in which the original spots may be recognized by their now darker color, usually very numerous, scattered all over the leaf; tufts hypophyllous, prominent, so numerous as to appear confluent over much of the spot except in section, rather large, composed of about 10–30 or more hyphæ which arise through stomata and are densely packed for a short distance below the surface, but are somewhat divergent above; hyphæ slightly dusky, simple, continuous or rarely 1 or 2 septate, scarcely tapering, but often abruptly narrowed, then truncate-rounded at the tip, rather short, the portions above the surface of the leaf being 20–65 by 3–6μ, but mostly 30–45 by $3\frac{1}{2}$–5μ, usually furnished with one or more prominent shoulders near the tip marking the places where conidia were attached, usually nearly straight, but sometimes bent—commonly at the base or near the tip; conidia abundant, evidently dusky, but not quite as deeply colored as the hyphæ, stout, subclavate or cylindrical, narrowed, then rather abruptly truncate at both ends, the basal segment usually somewhat wider than the others, 1–3-septate or rarely continuous, gradually, but evidently narrowed at septa—especially at the middle one, usually strongly curved (often principally at the middle septum), sometimes only slightly curved and rarely straight, variable in length, 33–72μ long, 4–5μ in diameter at basal segment, and 3–5μ in diameter at upper segment, mostly 40–70μ long, $4\frac{1}{2}$–5μ in diameter below, and 3–$4\frac{1}{2}\mu$ in diameter above, wall evident, rather thick ($\frac{1}{2}$–1μ). On lower leaves of medium sized trees of *Juglans nigra.* Manhattan, Kans., August 19, 1887. (No. 1079.) This species is readily distinguished by the color, shape, and thick walls of its conidia. The portions of the hyphæ below the surface of the leaf are very short, straight, and perhaps narrower than the portions above. When septate the hyphæ are narrowed at the septa much as are the conidia. The mycelium is abundant, much branched and septate, and about $2\frac{1}{2}$–4μ in diameter. The species was moderately abundant when found, and had evidently injured many of the leaflets attacked. It is very possible that it might do considerable damage if it attacked very young trees.

UREDO KANSENSIS, *n. s.* Spots amphigenous but more prominent above; rather sparse, definite or becoming subindefinite; at first greenish yellow with a nearly green center, at length becoming clear brown, very often marginal or running to the margin, subangular; roundish, or, when marginal, subtriangular. Sori hypophyllous or rarely also epiphyllous, very prominent, at first rather small, $\frac{1}{4}$–$\frac{3}{4}^{mm}$ in diameter, but soon by confluence becoming large (1–3^{mm} in diameter), annular, inclosing a small space occupied by spermogonia, appearing of a dull greenish

color, surrounded by numerous, hyaline, clavate, incurved paraphyses, which are about 50-90μ long and 13–20μ in diameter at the top; spores at first obovate or oval, hyaline, when mature oval, subglobose, or sometimes pyriform or elliptical, slightly sordid, in mass appearing of a slightly dirty yellow color, usually slightly and sometimes strongly papillate; 17–35 by 15–22μ, mostly 26–31 by 19–21μ, very easily falling off the pedicels, which are rather obscure, hyaline, closely packed, persistent on the host, forming a dense layer about 30–50 by 3μ; spermogonia amphigenous, occupying the center of the spot, rather numerous, black or dark brown, superficial, depressed, papillate, apparently sterile, 75–100μ in diameter. On leaflets of *Amorpha fruticosa*. Rooks County, Kans. Summer, 1884 (No. 773). June 20, 1888 (Mr. E. Bartholomew, No. 223). Manhattan, Kans., June 21, 1887 (No. 905). June 20, 1889 (No. 1490). Ellis & Everhart, North American Fungi, No. 2255 a (but not b), sub. nom. *Puccinia amorphæ*, Curtis.

This species is very peculiar both in color and in possessing spermogonia. It is very distinct from the uredo stage of *Uropyxis amorphæ*, (Curt.) Schrœt. and appears earlier. The spores seem to originate at the bottom of the layer of pedicels and to be carried up by the growing pedicel. The mycelium is abundant, hyaline, branched and septate 2–3μ in diameter. The cells of the host, which are attacked, usually contain very numerous small (3–5μ) oval, or globose starch grains.

NOTES ON NEW OR RARE FUNGI FROM WESTERN NEW YORK.

By Charles E. Fairman.

The student of mycology in New York turns to the invaluable reports of Prof. C. H. Peck whenever he wishes to ascertain if a given species has been found within the limits of the State. The purpose of this article is to indicate certain species, which have been found in New York, but are not, so far as the author knows, listed in the reports of Professor Peck.

Didymium Fairmani, Sacc., *n. s.* Peridia scattered, sessile, flocose, hyaline, widely reticulate; spores smooth (8–10μ in diameter); thickly studded with crystals; columella subglobose, brownish. On leaves of *Smilacina bifolia*. August, 1886, Lyndonville, Orleans County, N. Y.

Coniosporium Fairmani, Sacc., *n. s.* Differs from the allied *C. apiosporiodes* by its much fewer conidia (5–7μ in diameter), globose, smooth, fulgineous, one nucleate. On cortex of Hubbard squash, exposed to the weather. The fungus covers the surface with black sooty patches. Lyndonville, N. Y., February 10, 1886.

Cytosporina ailanthi, Sacc., and what may be *Phoma ailanthi*, Sacc., occur on *Ailanthus glandulosus*, sparingly, in company with the more common *Camarosporium subfenestratum*, B. & C. *Cytisporium Neesii*, Cda., attacks birches used as ornamental trees.

DIPLODIA JUGLANDIS, Fr., on black walnut, April, 1888.

DIPLODIA ÆSCULI, Lév.

DIPLODIA SAMBUCINA, Sacc. Rare.

DIPLODIA MAURA, C. & E. var. A form of this species has been found on *Pirus Americana*, which Mr. Ellis has designated as var. *Americana.*

DIPLODIA EXTENSA, Ck. & Hark. in Grev., 1881, p. 83. Occurs on bark of dead maple saplings.

DIDYMELLA LINDERÆ, (?) E. & E. On *Lindera benzoin*, April, 1889. Spores fusoid, hyaline, 4 nucleate, 18–20 by 4–5μ.

DIDYMELLA RANII, E. & E. Bull. Torr. Bot. Club, X, p. 90. The feature of our specimens is the absence (in those examined) of paraphyses. Sec. Ellis, in Lett. April 16, 1887, "If there are no paraphyses this will be a *Sphærella.*"

EUTYPA VELUTINA, (Wallr.) and *Eutypa flavo-virescens*, (Hoff.) Tul. occur rarely on decorticated branches.

FENESTELLA AMORPHÆ, E. & E., has occurred for two years on small fallen hickory limbs growing while the bark was on the limb (see Journ. Mycol.).

HAPLOSPORELLA NERII, Sacc., has been found on dead stems of oleander.

HYSTERIUM FRAXINI, Pers., was found on basswood in good quantity. This is a rare habitat for this species.

MORTHIERA THÜMENII, Ck., var. *sphærocysta*, Peck. This species has been found abundantly on *Cratægus* at North Ridgeway on the County Line Road between Orleans and Niagara Counties, N. Y. The *Cratægus* trees were in use as a hedge, and the fungus bade fair to seriously impair the vitality of the plants, and certainly detracted from the beauty of their foliage. Professor Peck, to whom specimens were referred, says (in lett.) "the cells are nearly globular in your specimens, and I call it variety *sphærocysta.*" *Metasphæria leiostega*, Ell., occurs on rose stems in company with *Didymella ranii.*

PHYLLOSTICTA CIRSII, Desm., occurs on leaves of Canada Thistle, and *Phyllosticta phomiformis*, Sacc., on oak leaves.

SEPTORIA STELLARIÆ, R. & D., is quite common at Lyndonville on common chickweed about door-yards, and is easily overlooked.

SEPTORIA MALVICOLA, E. & M., is abundant on *Malva rotundifolia* and often checks the growth of that weed.

SEPTORIA DIVARICATA, E. & E., was found on *Phlox divaricata*, Ridgeway, Orleans County, N. Y.

VERMICULARIA PHLOGINA, Fairman, in Bot. Gaz., March, 1887, attacks the phlox in the same locality, a little later in the season.

ZYGODESMUS MURICATUS, E. & E., Bull. Torr. Bot. Club, 1884, p. 17, rarely observed. Color nearer lilac than rose purple.

AGARICUS ADIPOSUS has been found growing from the base of living apple trees or from roots. Hartig has made the subject of root

parasites a special study (Die Pflanzlichen Wurzelparasiten), and has enumerated many species.

All the species here enumerated were found, when not otherwise indicated, at Lyndonville, N. Y.

NOTES ON THE FUNGI OF HELENA, MONT.

By Rev. F. D. Kelsey.

The following notes are merely a résumé of one year's study of our local fungi; it is necessarily very meager, as my work in botany is done at intervals in a very busy professional career.

The following parasitic fungi have been found by me within a few miles of the city of Helena, Mont., in 1888:

Æcidium abundans, Pk. On *Symphoricarpus occidentalis.*
S. racemosus, var. *pauciflorus.*
Æcidium berberidis, Geml. On *Berberis repens.*
Æcidium chrysopsidis, Ell. & And. On *Chrysopsis villosa.*
Æcidium clematidis, DC. On *Clematis Douglasii.*
Æcidium gaurinum, Pk. On *Gaura coccinea.*
Æcidium glaucis, Dozy & Molkenb. On *Glaux maritima.*
Æcidium hemisphæricum, Pk. On *Lactuca pulchella.*
Æcidium intermixtum, Pk. On *Iva axillaris.*
Æcidium plantaginis, Ces. On *Plantago eriopoda.*
Æcidium porosum, Pk. On *Vicia Americana.*
Æcidium pyrolatum, Schw. On *Pyrola rotundifolia.*
Æcidium ranunculacearum, DC. On *Ranunculus Cymbalaria.*
Anemone multifida.
Æcidium thalactri-flava (DC.) Wint. On *Thalictrum Fendleri.*
Melampsora cerastii, (Pers.) Schrœt. On *Cerastium arvense.*
Uromyces hedsaryi-paniculati, (Schw.) Farlow. I. and III. On *Hedysarum boreale.*
Uromyces spraguæ, (Hark.) I. and III. On *Lewisia rediviva.*
Uromyces trifolii, (Hedw.) Lév. On *Glycyrrhiza lepidota.*

I have in herbarium collected the year previous by F. W. Anderson the following:

Æcidium grossulariæ, DC. On *Ribes floridum.*
Æcidium urticæ, (Schw.). On *Urtica gracilis.*
Coleosporium sonchi-arvensis, (Pers.) Lév. On *Solidago Missouriensis.*
Cronartium asclepiadeum, var. Thesii, Berk. On *Comandra pallida.*
Melampsora epilobii, (Pers.) Winter. II. On *Epilobium coloratum.*
Melampsora lini, (Pers.) Winter. On *Linum Lewisii.*
Melampsora populina, Lév. On *Populus tremuloides.*
Melampsora salicis-capreæ, (Pers.) Wint. On several species of *Salix.*
Phragmidium fragariæ, DC. II. and III. On *Potentilla* sp.
Phragmidium subcorticium, (Schrank.) Winter. I. and III. On *Rosa Sayi*? or *blanda*?

PUCCINIA ASTERIS, Duby. On *Aster commutatus.*
PUCCINIA CLADOPHILA, Pk. On *Stephanomeria runcinata.*
PUCCINIA FLOSCULOSORUM, (A. & S.) Wint. On *Balsamorrhiza sagittata.*
III. On *Cnicus undulatus.*
PUCCINIA FUSCA, (Rel.) Wint. On *Anemone multifida.*
PUCCINIA GRAMINIS, Pers. On *Distichlis maritima.*
PUCCINIA GRINDELIÆ, Pk. On *Grindelia squarrosa.*
PUCCINIA INTERMIXTA, Pk. I. and III. On *Iva axillaris.*
PUCCINIA MENTHÆ, Pers. On *Mentha Canadensis* var. *glabrata.*
I. and III. On *Monarda fistulosa.*
PUCCINIA MIRABILISSIMA, Pk. On *Berberis repens.*
PUCCINIA PHRAGMITIS, (Schw.) Kornike. On *Spartina cynosuroides.*
PUCCINIA POLYGONI-AMPHIBII, Pers. On *Polygonum Muhlenbergii.*
PUCCINIA SAXIFRAGÆ, Schl. On *Heuchera cylindrica.*
PUCCINIA TANACETI, DC. II. *Helianthus Californicus* var. *Utahensis.*
PUCCINIA VIOLÆ, DC. II. On *Viola canina* var. *sylvestris.*
ENTYLOMA COMPOSITARUM, Far. On *Helianthus annuus.*
USTILAGO SEGETUM, (Bull.) Wint. On Cult. Oats.
ERYSIPHE CICHORACEARUM, DC. On *Artemisia Ludoviciana.*
Grindelia squarrosa.
Bigelovia graveolens var. *albicaulis.*
Aster commutatus.
Solidago serotina.
Aster lævis.
ERYSIPHE COMMUNIS, (Wallr.) Fr. On *Amelanchier alnifolia.*
Ranunculus Cymbalaria.
PHYLLACTINIA SUFFULTA, (Reb.) Sacc. On *Cornus stolonifera.*
Betula occidentalis.
PODOSPHÆRA OXYCANTHÆ, DBY. On *Prunus Virginiana.*
SPHÆROTHECA MORS-UVÆ, (Schw.) B. & C. On *Ribes floridum.*
UNCINULA SALICIS, (DC.) Wint. On *Salix flavescens.*
Populus tremuloides.
DIMEROSPORIUM POPULI, E. & E. *Populus tremuloides.*
CYSTOPUS CANDIDUS ? (Pers.) Lév. On *Sisymbrium linifolium.*
S. canescens.
CYSTOPUS TRAGOPONIS, (Pers.) Schrœt. On *Senecio serra.*
S. aureus var. *croceus.*
VALSA NIVEA, (Hoffm.) (Spermogonia). On *Populus tremuloides.*
PHYSALOSPORA MEGASTOMA, (Pk.) Sacc. On *Astragalus hypoglottis.*
SPHÆRELLA PACHYASCA (?), Rost. (Fungi Greenland.) On *Phlox Douglasii.*
LEPTOSPHÆRIA ARTEMISIÆ, (Fuck.) Auersw. On *Artemisia cana.*
LEPTOSPHÆRIA TYPHARUM, (Desm.) Karst. On *Typha latifolia.*
CLAVICEPS PURPUREA, (Fr.) Tul. On *Elymus condensatus.*
HYPOCREA RICHARDSONI, B & M. On *Populus tremuloides.*
NECTRIA RIBIS, (Tode) Rabh. On *Ribes* (dead branches).
DOTHIDEA ———: stylosporous stage. On *Helianthus Californicus* var. *Utahensis.*
DOTHIDEA BIGELOVIÆ, E. & E. n. sp. On *Bigelovia* sp.
ACTINONEMA ROSÆ, Lév. On *Rosa Sayi*, or *blanda.*
ASCOCHYTA COLORATA, Pk. On *Fragaria vesca.*
ASTEROMA RIBICOLUM, E. & E. n. sp. On *Ribes floridum.*
CYSTOSPORA CHRYSOSPERMA, Pers. On *Populus tremuloides* (decaying bark).
PHOMA MAMILLARIÆ, (Web.) On *Opuntia Missouriensis.*

ENTOMOSPORIUM MACULATUM, Lév. On *Amelanchier alnifolia.*
BOTRYTIS LUPINI, E. & E. On *Lupinus leucophyllus.*
DIDYMARIA CLEMATIDIS, Cke. & Hark. *Clematis ligusticifolia.*
OIDIUM ERYSIPHOIDES, Fr. On *Echinospermum Redowskii.*
HETEROSPORIUM CLEOMIS, E. & E. n. sp. *Cleome integrifolia.*
RHYTISMA SALICINUM, Tr. On *Salix flavescens* var.
DERMATIA POPULINA, Schw. On *Populus tremuloides.*

SUPPLEMENTARY NOTES.

By F. W. ANDERSON.

The foregoing list was kindly sent to me by the Rev. F. D. Kelsey, with the request that I add any names and notes at my command. Having in 1887 spent several months collecting in the vicinity of Helena in company with Mr. Kelsey, and collected in the same neighborhood again in 1888, it is with pleasure I add the following:

Although the combined list is small, it extends the ranges and hosts of some species, besides giving a few new to science.

ÆCIDIUM CLEOMIS, Ell. & Anderson. On *Cleome integrifolia.* Appearing chiefly on young plants, affecting the leaves and petioles, and occasionally the stems.

ÆCIDIUM COMPOSITARUM, Mart. Very abundant on *Troximon glaucum*, often destroying leaves of feeble hosts. Same on *Solidago rigida.*

ÆCIDIUM LEPIDII, Tracy & Galloway. On *Lepidium intermedium.* A beautiful scarlet species, the broad, white marginal lobes contrasting strongly with the rich color below. Not very common.

ÆCIDIUM MONOICUM, Pk. On *Sisymbrium linifolium.* One of the earliest to appear. Changes structure of host leaves, causing them to become oval or roundish in outline and much thickened and brittle, margin strongly recurved. Preceded by the remarkably fragrant spermogonia which exude a sticky fluid with a perfume between that of the English Sweet Violet and Hedge Primrose. This fluid is very attractive to beetles, flies, bees, and ants. A destructive fungus having several known hosts and which may in time, perhaps, attack cultivated *Cruciferæ.*

ÆCIDIUM URTICÆ, Schum. On *Urtica gracilis*, was very abundant in Oro Fino Gulch, near Helena, in 1887. It damaged its host considerably.

PHRAGMIDIUM POTENTILLÆ, (Pers.) Wint. On *Potentilla Pennsylvanica* and *P. dissecta* (mountain form). Common and very conspicuous. The rich reddish, orange-colored uredospores are frequently present with the large, black, velvety teleuto-sori, forming a marked contrast.

PUCCINIA ABERRANS, Pk.? On *Sisymbrium linifolium.* Succeeding *Æcidium monoicum* as a rule, but sometimes appearing on the same leaves while the latter is at its best. This is said to differ from the type. I have a typical specimen of this *Puccinia* on the first published host. I also have it varying more or less from the type form on several hosts in other genera from Colorado, Washington Territory, and Utah. No two are alike but all are evidently of one species. The form on *Sisymbrium linifolium* seems to fit in with the rest and if another species it is closely related to *P. aberrans.*

PUCCINIA CARICIS, (Schum.) Wint. On *Carex Jamesii* var. *Nebraskensis, Carex filifolia, Carex Douglasii, Carex Pennsylvanica, Carex marcida* and *Carex utriculata.* The other *Carices* of this locality do not seem to be affected by the parasite.

PUCCINIA CLADOPHILA, Pk. On *Stephanomeria minor*. Very abundant at the summit of Mt. Helena. It also occurs on *S. runcinata*.

PUCCINIA RUBIGO-VERA, (DC.) Wint. On *Agropyrum divergens*, *Elymus condensatus*, *Kœleria cristata*, and several other grasses.

PUCCINIA FLOSCULOSORUM, (A. & S.) Wint. On *Troximon glaucum*. That this host occurs in Montana is doubted by some, but it certainly does. Rev. F. D. Kesley also has the fungus on this host.

PUCCINIA GALIORUM, Lk. On *Galium boreale*. Rather uncommon.

PUCCINIA GILIÆ, Pk. ? On *Phlox cæspitosa* var. *condensatus*. Common and very destructive to host.

PUCCINIA GRAMINIS, Pers. On *Agropyrum violaceum*. Common.

UROMYCES ERIOGONI, Ell. & Hark. On *Eriogonum umbellatum*. Apparently rare in this vicinity.

UROMYCES JUNCI, (Desm.) Wint. On *Juncus longistylis*. The fungus has been present wherever I have found this host in Montana, but I have not succeeded in finding it upon another host, even of the same genus.

UROMYCES TEREBINTHI, (DC.) Wint. On *Rhus toxicodendron*. Not abundant.

UROCYSTIS COLCHICI, (Schl.) Wint. In the leaf tissue of *Smilacina stellata* growing in shady places.

USTILAGO SEGETUM, (Bull.) Wint. On *Hordeum jubatum*. More common on this host than upon cultivated cereals.

TUBERCULINA PERSICINA, (Ditm.) Sacc. On the cups of *Æcidium porosum* Pk. on *Vicia Americana* var. *linearis*. Common.

TUBERCULINA VINOSA, Sacc. ? On *Lactuca pulchella* with *Æcidium hemisphæricum* Pk. Common.

ERYSIPHE CICHORACEARUM, DC. On *Aster longifolius*, *A. commutatus Chrysopsis villosa*, and *Cnicus undulatus*. Very common.

ERYSIPHE COMMUNIS, (Wallr.) Fr. On *Vicia Americana*, var. *linearis*, *Oxytropis Lamberti*, and *Ranunculus repens*. Very scarce here on the *Oxytropis*.

PHYLLACTINIA SUFFULTA, (Reb.) Sacc. On *Typha latifolia*. Rather common on this host in a marsh along Ten-mile Creek near Helena.

SHPÆROTHECA CASTAGNEI, Lév. On *Ribes floridum* in damp woods. Common.

PERONOSPORA GANGLIFORMIS, (Berk.) DBy. On *Lactuca pulchella*. Rather frequent on hosts growing along the borders of the damp woods and thickets.

PERONOSPORA MYOSOTIDIS, DBy. On *Echinospermum Redowskii* Leh. and *Echinospermum floribundum*. Common and extremely injurious to the former host, often killing it; more uncommon on the latter and usually less harmful.

PERONOSPORA PYGMEÆ, Unger. On upper leaves of *Anemone multifida*. I found this only on one occasion, viz. near the summit of Mount Helena, June 8, 1887.

CRYTOSPHÆRIA MILLEPUNCTATA, Grev. On bark of *Populus tremuloides*. Common.

VALSA LEUCOSTOMA, (Pers.) Fr. On bark of *Prunus Virginiana*. Common.

DIDYMOSPHÆRIA EURYASCA, Ell. & Gal. On dead leaves of *Pinus Murrayana*, at the summit of Mount Helena.

PLEOSPORA HERBARUM, (Pers.) Rabh. On dead stems and leaves of *Cymopteris bipinnatus*, *Actinella acaulis*, *Aplippapus integrifolius*, *Oxytropis Monticola*, and many other plants.

PLEOSPORA PERMUNDA, (Cke.) Sacc. On *Clematis ligusticifolia*.

PHLEOSPORA OXYTROPIDIS, Ell. & Gal. On *Oxytropis Lamberti*. Quite destructive to the leaves and flower stalks of host, causing the leaflets to fall away and the flowering peduncles to dry up.

PENIOPHORA OCCIDENTALIS, E. & E. On bark of *Salix amygdaloides* and *Prunus Virginiana*.

SPHÆRIA (DOTHIDEA) LACTUCARUM, Schw. On *Lactuca pulchella*. Common and injurious to the host.

CLAVICEPS PURPUREA, (Fr.) Tul. On *Agropyrum violaceum* and on *A. divergens*.

PLOWRIGHTIA FRUTICOLA, E. & E. On dead stems of *Clematis ligusticifolia*.

PLOWRIGHTIA MORBOSA, (Schw.) Sacc. On branches of *Prunus Virginiana*. Common.

PLOWRIGHTIA SYMPHORICARPI, Ell & Gal. On dead stems of *Symphoricarpus occidentalis*. Common.

CINCINNOBOLUS CESATII, DBy. In the hyphæ and conidia of *Erysiphe cichoracearum* DC. and on *Cnicus undulatus*. I found these specimens near Helena in October of last year. Of all the *Erysiphe* on various hosts I have collected in various parts of Montana this was the only specimen bearing this secondary parasite.

PHOMA THERMOPSIDIS, Ell. & Gal. On dead stalks of *Thermopsis rhombifolia*. I found this on an old stalk attached to a fine Phænogamic specimen given me by my friend, Kelsey.

RHINOTRICHUM CURTISII, Berk. On old logs in damp situations, apparently very partial to charred wood.

ZYGODESMUS OBTUSUS, E. & E. On dead wood of *Populus monilifera*.

CLADOSPORIUM GRAMINUM, Corda. On *Poa tenuifolia*. Common.

CLADOSPORIUM HERBARUM, (Pers.) Lk. Common on dead or diseased stems and leaves of various plants.

CLADOSPORIUM TYPHARUM, Desm. On *Typha latifolia*. Common.

MACROSPORIUM IRIDIS, C. & E.? On *Iris Missouriensis*. Common and destructive.

MACROSPORIUM INQUINANS, C. & E. On dead stems of *Helianthus annuus*.

CRUCIBULUM VULGARE, (Tul.). On dead sticks of *Juniperus Virginiana*, also on twigs buried in damp soil. Rather common in moist, shady places on Mt. Helena.

CYATHUS VERNICOSUS, (Bull.) DC. On moist ground, Mt. Helena. Fine specimens also grew in Mr. Kelsey's front lawn last summer, where the garden hose was habitually left upon the grass with the water gently flowing.

PHLEBIA MERISMOIDES, Fr. On dead bark of *Populus tremuloides* and *Salix flavescens*.

TRICHODERMA LIGNORUM, (Tode.) Harz. On dead and decaying trunks of trees.

These names and notes have been culled from my note-book. Neither Mr. Kelsey nor myself have attempted any systematic work with the *Hymenomycetes*, owing to the great amount of time and work necessary for their successful preservation. But we have many edible species here, some kinds of which I have frequently eaten, and it is our hope this year to get together all the Hymenomycetous fungi we can find.

SOME FUNGI OF CUSTER COUNTY, COLO.

By T. D. A. COCKERELL.

Mr. Anderson's interesting notes in the last number of the Journal suggest a few remarks on the fungi found here at 8,000 feet and upwards, because we have already all his species. *Claviceps purpurea* occurs with us as high as 8,400 feet, but is rather locally distributed. *Ustilago segetum*, contrary to Mr. Anderson's experience, is quite abundant and injurious to the grain crops, though varying in its destructiveness in different years. The threshing operations must tend greatly to disseminate the spores, which very readily fly into the air to the annoyance of those working round the machine.

We have two species of *Æcidium* that are puzzling, and I do not

know what to call them. One occurs on *Artemisia* and is evidently the same as that found by Mr. Anderson, while the other is found on *Berberis repens*, and is that described by Messrs. Tracy and Galloway in Bot. Gaz., 1888, pp. 126, 127. When I first found them, I called them in my notes *Æcidium artemisiæ* and *Æcidium repentis*, respectively, and I knew what these names referred to. Now, they stand as *Æcidium tanaceti* and *Æcidium mirabilissima*, on the strength of their assumed connection with the *Puccinias* of the same specific names, but I do not feel quite easy about them. In the first place, the *Artemisia Æcidium* may not have anything to do with *P. tanaceti* after all; at any rate, it grew in great abundance just outside the door of my house, and I never saw any of the *Puccinia*. It is much brighter, more orange in color than *Æcidium compositarum*, which grew abundantly on *Aster lævis* at the same place (8,400 feet alt.). Secondly, the *Berberis Æcidium* may or may not be *P. mirabilissima*. It is exceedingly local, and if the *Puccinia* is as local, I may easily have overlooked it, for I never yet saw it, though I have examined any amount of *Berberis*. There is a *Puccinia*, very abundant, that was thought to be a form of *graminis*, and a possible connection with the *Æcidium* was suggested, but it now proves to be *P. caricis*. Another *Æcidium* we have in great abundance is *Æcidium euphorbiæ* on *Euphorbia montana*, and on the same plants occurs *Uromyces scutellatus*, so these may be connected. *Æcidium monoicum* is also abundant early in the year on *Arabis*, distorting the host plant so much that it becomes unrecognizable.

As with Mr. Anderson, *Phragmidium subcorticium* is very abundant on roses, especially *Rosa blanda* and its varieties. *Melampsora salicina* we get on the willows as high up as 10,000 feet.

I am now preparing a list of fungi of this region for the Colorado Biological Association, which becomes possible only through the kind help of Mr. J. B. Ellis, who examines and identifies the species, and assists in every way. Many interesting forms have been met with, all of which will be noticed in due time.

NOTES UPON SPHÆROTHECA PHYTOPTOPHILA, KELL. AND SWINGLE.

By B. D. Halsted.

Some hackberry (*Celtis occidentalis*) trees upon the Agricultural College grounds at Ames, Iowa, are quite badly infested with a mite (Phytoptus) causing prominent distortions of the young branches which frequently form bushy tufts of dwarfed stems that may be seen several rods away, when the trees are not in leaf. While investigating the healthy twigs and those which had been distorted by the mite, to determine the differences in the amount and disposition of the starch and

other reserve materials in mid-winter (January 19, 1889), it was found that the diseased parts were doubly infested. The basal portion of the bud scales were almost coated over with small, nearly spherical, dark bodies which proved to be the perithecia of the new species of powdery mildew, *Sphærotheca phytoptophila*, recently found in Kansas, and described by Professors Kellerman and Swingle in the September issue of the Journal of Mycology, page 93. At this season of the year all traces of the mildew are absent from anything except the infested or abnormal branches, and upon these the perithecia are limited to the bud scales, with a particular preference shown to the lower portion of the scale. Upon further study, the buds infested were found to be much larger than those upon healthy branches and contained the perithecia in all their tissues. For example, a bud well up from the base of a twig might not show any signs of perithecia upon the exterior, but when the large loose scales were removed the bases of the inner ones would expose a dark covering consisting of the mildew perithecia. Longitudinal sections through such buds showed that the living tissue of an ordinary bud was absent, and its space was occupied by an entangled mass of fungous fruit.

It is quite unusual to find a powdery mildew which is so particular as this one in the selection of the place for bearing the perithecia, both as to the character of the branch it selects (an abnormal one) and the part upon it. As fungus parasites thrive upon compounds rich in albuminous substances, and as the *Phytoptus* induces a rapid and therefore comparatively succulent growth upon a tree that normally has a dense wood, firm bark, and minute, closely protected buds, it may however not be so strange that the *Sphærotheca* will flourish upon the distortions caused by the mite when it fails to gain a foothold upon a healthy twig. The extremely favorable conditions offered by the "birds' nests" of soft, green, nourishing tissue, developed through irritation of the mite, probably have vastly more to do with the presence of the fungus than any lack of vital activity or so-called resisting power in the diseased twigs. It is in these parts that the *Celtis* makes much more rapid growth than in the normal parts. It was, moreover, observed that in a cross-section of the stimulated branch there was considerable starch scattered through the bark, while in the healthy and mature twigs, where the buds were normal, smooth-coated, and varnished, there was no starch outside the ring of firm wood. This starch in the bark may be the secret of the success of the *Sphærotheca* upon the infested branches, for the substance under the action of organic ferments yields grape sugar, a most acceptable food for parasitic fungi. If the powdery mildew was a deep feeder like the *Peronosporas* the conditions would be different and the nearness of food supply to the surface of the host of less consequence.

SMUT-FUNGI.

RECENT DISCOVERIES AS TO THE NATURE AND ACTION OF USTILAGINEÆ.*

It is hardly too much to say that the man who clears up the life history of smut-fungi and gives to the world an intelligible account on which a successful treatment can be based, realizes the proud achievement of making two blades of grass grow where only one grew before—a feat worthy of the most devoted consideration of citizens and statesmen, as we have been told on high authority. Perhaps the honor is already due to those botanists—Kühn, R. Wolff, De Bary, and Brefeld—who, following on the earlier and chiefly anatomical investigations of Fries, Persoon, Corda, Meyen, Léveillé, Bonorden, and especially the Tulasnes, gradually demonstrated the biological nature of the *Ustilagineæ*, those subtle fungi which cause the smuts of cereals and onions, etc., the bunt of wheat, and a large number of similar diseases on all kinds of valuable plants.

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For many years previous to about 1840 little was known of these fungi beyond the fact that the bunted or smutted grains of corn were transformed into a dark, powdery mass of minute spores. Somewhat later (I believe first by Bonorden, in 1851) it was found that although, when ripe, there is nothing but spores in the blackened grain of corn, etc., in a somewhat younger condition these spores can be shown to arise from delicate fungous filaments, just as in the case of other fungi. At any rate, this was known to De Bary in 1853, from his own researches on the smuts of maize and other plants, and is now thoroughly established. But although it is now very easy to show the fungous filaments, or mycelium, in the case of some *Ustilagineæ*, they are in others so delicate and so transparent that the most refined methods and practice are necessary to demonstrate their presence. Nevertheless, the dark spores in all cases arise in tufts from the ends of more or less fine filaments. In some cases these filaments have distinct walls and septa, and send suckers (haustoria) into the cells of the tissues; in others they are so minute that it is extremely difficult to say whether they consist of anything more than strands of protoplasm. In some species they are abundant, in others sparse. In many species these fungous filaments can be traced for considerable distances from the diseased spots; in others they are confined to local centers. These characters, as well as other peculiarities respecting the branching, mode of spore formation, gelatinization of the walls, etc., need not occupy us here however, though they are of importance to the mycologist.

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* H. Marshal Ward in Gardener's Chronicle, Vol. V, p. 233.

GROWTH OF THE FUNGUS.

The outcome of all this may be summed up as follows: When the spore is allowed to germinate in water the tough outer skin bursts, and a thin hyaline cellulose membrane inclosing the swelling protoplasmic contents emerges as a delicate tube. In some cases this tube protrudes through a definite thin spot; in others no germination could be induced in water, even though plenty of air was present and the temperature normal. The older the spore the longer the time required before germination.

When the above germinal tube has attained a length of, say five or six times the diameter of the spore, it breaks up into segments, and begins to put out numerous bud-like branches, which soon separate as single cells, looking very like cells of the yeast plant. These yeast-like cells have usually been called sporidia. In some species the sporidia are long and thread-like, and are produced in a sort of coronet. Other varieties in detail occur, but our purpose is served if the reader apprehends that the usual mode of germination in water is for the spore to put forth a short tube (the so-called pro-mycelium), from which several sporidia are then budded off.

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HOW AND WHERE THE FUNGUS ENTERS THE PLANT.

The first steps in the elucidation of the extremely difficult problems here involved were taken by Hoffman, Kühn, and Wolff during the period between 1866 and 1880. Kühn was the first, I believe, to actually perceive the penetration of the fungus into the plant. He showed that if the spores of the bunt fungus (*Tilletia*) are sown with the wheat grains they germinate and produce their promycelia *pari passu* with the emergence of the radicle of the young wheat seedling; from the promycelia are developed the now well known sporidia, and these sporidia then put forth extremely fine fungous filaments, which penetrate the young and delicate tissues of the embryo wheat plant, somewhere in the part (collar) common to root and shoot. Kühn repeated his experiments successfully with the smut of corn, and with several other species, always finding the incipient mycelium of the fungus in the delicate collar. After some years of research Kühn concluded that the normal mode of infection common to the majority of these fungi is the following: The spores ripen in the smutted and bunted cereals with the grain, and are garnered with the latter; they become scattered on the healthy grains, and may be sown in the following spring with these. As the young cereal germinates, the attached spores produce their promycelia and sporidia, and the germ-tubes from the latter penetrate the embryo corn plant. But now came the *crux*. If the fungus is such a virulent parasite as it was made out to be, how is it that we see little or no more of its effects until the late summer and autumn, when the grain begins

to ripen? It is true, refined investigations proved that the mycelium could be discovered in small quantities in the corn plants as they grew larger and older, but it seemed to do no harm; but are we to believe that this mycelium can go on growing in and with the tissues of the corn plant, only to exert their destructive effect months afterwards as the grain begins to ripen?

Astonishing as this may seem it turned out to be the case. R. Wolff in 1873 repeated Kühn's experiments with smuts, etc., and practically confirmed them in every particular; it is true he went a little too far in concluding that only a certain organ (the first leaf sheath) is susceptible to the infection, and Kühn's results were shown to be more accurate in this respect, but the primary fact remains that the sporidia are able to effect an entry into the host-plant by means of their germinal tubes only, provided they attack the embryonic tissues, and especially the cells of these delicate young embryos; once inside, the delicate fungous filaments grow on with the tissues, gradually permeating every part of the plant until, with the development of the young fruit, they meet with the conditions for the fulfillment of their own last purpose—the production of spores. Further investigations only succeeded in demonstrating the correctness, in all essential particulars, of these views.

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DRESSING.

As early as 1781, and even earlier, several observers had satisfied themselves of the infectious character of these diseases, and even in 1820 it had been shown that washing the seed corn with copper-sulphate before it was sown resulted in a diminution of the number of diseased ears; and many interesting experiments were made from time to time tending to prove that (1) if smutted grains are mingled with clean ones, the sowings give an enormously higher percentage of diseased ears; (2) the more the seed-grain is cleaned from adherent spores, the less the percentage of diseased ears; (3) it is only in the early stages of the germination of the grain that the danger of the infection is great.

It was from this foundation that the now well-known process of "dressing" wheat took its origin, and to this may be added some "practical" measures introduced as the outcome of experience, and taught empirically. Let us glance at the results in the light of what is already known. One of the commonest and best-known methods of "dressing" is to steep the grain for some hours in a dilute solution of copper-sulphate in water. The object is to cause so much of the poisonous salt to stick to the coats of the "seed-grain" as will kill the delicate promycelia and sporidia before the latter can penetrate the young corn plant. The chief danger is lest the young seedling should have its delicate tissues injured. Other dressings are used in addition to the above; salts of lime, soda, etc., arsenic, permanganate of potassium, carbolic

acid, and many other substances have been tried and advocated, and various processes for steeping or washing the grain, or for blowing off spores with powerful draught of air, have found more or less favor. In all these cases the result aimed at is to keep the germinating wheat, etc., from contact with the spores, and no one is likely to call in question the wisdom of the intention.

But another question obtrudes itself here, and that is: If the sporidia can really infect the young wheat seedling, etc., only in the stage and at the place described, then should it not be possible to attack the question of protection from another stand-point? In other words, if the fungus can only enter the tender tissues at the collar of the young seedling, then a few hours more or less in the time occupied in the process of germination may make all the difference to the seedling. All these conditions or adaptations which hurry or facilitate the vigorous germination of the seed must lessen the danger of infection, and if it can be shown conclusively that this is the case, an important service to the community has once more been rendered by the biologists. The ground is a little difficult, however, because, unless we are quite sure of our steps, it is somewhat easy to go astray from facts to hypotheses.

MUCRONOPORUS, E. & E.

By J. B. Ellis and Benj. M. Everhart.

The following additional species of *Polyporeæ* have the hymenium spiny:

MUCRONOPORUS *ferruginosus* (Schrad.) issued in N. A. F., 111, as *Polyporus contiguus*, Pers. The N. A. F. specimens were determined by Berkeley some twenty years ago from specimens sent him from Newfield, N. J. Spines abundant, well developed, 30–40 by 5–6μ. Specimens on osage-orange from Missouri (Demetrio, No. 138), and on *Vitis* from Ohio (Morgan, 577), agree in all respects with the Newfield specimens. In Fr. Epicrisis the pores are said to be equal ("æqualibus"). In N. A. F., 111, they vary from round to flattened and subsinuous, and agree in all respects with three specimens of *Poria ferruginosa* (Schrad) from Herb. Berkeley (kindly sent with many other things by Dr. M. C. Cooke). The N. A. F. specimens also agree much better with the description of *P. ferruginosa* than with that of *P. contigua*, and we have very little doubt in referring them to that species.

The specimen of *P. contiguus* in Rav. Fungi Car. I, 16, has the pores equal and round, or nearly so, and judging from specimens in our Herb. from Morgan (74 and 324) are the same as the "*P. unitus*, Pers." in "The Flora of the Miami Valley." The Ohio specimens are on wood of deciduous trees, and the same thing is not uncommon around Newfield on dry dead limbs of oak. Colonel Calkins also sends it from Florida (Nos. 65, 114, 126, 131) on dead limbs of various deciduous trees.

All these we are satisfied are the same, being at first of a yellowish cinnamon color, becoming darker (chestnut) and finally fading more or less, being made up of a thin (1–2^{mm} thick), continuous stratum of subequal, nearly round, pores connected at the base by a thin membrane and with a narrow sub-indefinite margin. The fungus often extends along the limb for 6 inches or more. The inner surface of the pores is constantly clothed with spines, but they are less abundant and mostly shorter (20–30μ) than in N. A. F., 111. There seems good reason to doubt whether this is the *P. unitus* Pers. It certainly does not agree with the figure in Fries Icones which represents it as growing in definite, orbicular, or oblong patches, with a definite margin. *P. unitus* is also said to grow on wood of fir trees and to be 4–5^{mm} thick. We should rather refer the *P. contiguus* of Rav. Car. and the *P. unitus* of the "Flora of the Miami Valley" to *P. floccosus*, Fr., Hym. Eur., 572. The *P. contiguus*, Fr., in deThümen's Mycotheca, 1303, on wood of *Picea vulgaris*, collected in Finland by Karsten, has somewhat the same general appearance, but is softer, has a more distinct margin, and is, as far as we can see, without spines. The Finland specimen certainly agrees better with the *description* of *P. contiguus* than any of the American specimens above mentioned, and is probably the species described by Fries.

MUCRONOPORUS OBLIQUUS, (Pers.). An authentic specimen from the herbarium of Fries and one from Dr. P. A. Karsten, Finland, have the hymenium very spiny. Spines at first ovate-conic, 8–12μ, soon elongated 15–30 by 6–8μ, some even 35–40μ long. The specimens in N. A. F. 313 are certainly not this species. The pores are smaller, color inclining more to yellow, and hymenium unarmed or with a very few short spines. There is hardly a doubt that this (N. A. F. 313) is a resupinate form of *Fomes igniarius*, or in some copies (specimens decidedly yellow and spores ferruginous) of *Fomes rimosus*, (Berk.).

MUCRONOPORUS SPISSUS, (Schw.). Specimen from Ohio (Morgan, 298) and from West Chester, Pa. (Everhart), both on hickory. Spines tolerably abundant, 15–25 by 4–5μ. This is a very different thing from the *P. spissus* in Herb. Schw. which appears to be the same as *P. salmoni color*, B. & C. This species (*P. spissus*, Ohio and Pennsylvania specimens) originates beneath the bark, which is soon thrown off directly over it, leaving the surface of the pores lower than that of the bark. The thin, narrow margin is closely attached to the broken margin of the surrounding bark, so as generally to be turned up perpendicularly, but is not properly incurved, though in old specimens after the surrounding bark has fallen away it may have something of that appearance. Whether it is the species described by Schweinitz may perhaps be doubted.

MUCRONOPORUS IGNIARIUS, (L.). Finland species from Karsten agree with those in de Thümens Austrian Fungi Nos. 714 and 1007 and Mycotheca Marchica 1504. Spines not abundant, 8–20 by 5–6μ. In poorly developed specimens and resupinate forms of this species the spines are either entirely wanting or very scarce. The specimens in N. A.

F. 915 are doubtful. There appear to be two species mixed, and neither of them in any of the copies now accessible to us are *P. igniarius*. In some of the copies certainly this number is *P. rimosus*, Berk., which is yellower and in the young stage of growth has the pileus subtomentose-velutinous, with the hymenium unarmed (as far as we have yet seen) and the spores *ferruginous*.

MUCRONOPORUS NIGRICANS, Fr. Finland specimens from Karsten agree perfectly with specimens collected by Miss Minns on birch trees in New Hampshire. Spines abundant, 12–20 by 5–6μ.

MUCRONOPORUS SALICINUS, (Pers.). Specimens from Karsten Finland. Spines tolerably abundant, 15–25 by 5–6μ. Specimens collected by Miss Minns in the Lake Superior region agree perfectly with the Finland specimens. Both this and the preceding (*M. nigricans*) have the pileus smooth, zoned, and black, but *M. salicinus*, according to the description and specimens, is for the most part resupinate with only a narrow reflexed margin, while in the typical *M. nigricans* the pileus is dimidiate without any effused or resupinate part extending down below it, but in this too there are forms either entirely or partly resupinate.

MUCRONOPORUS CONCHATUS, (Pers.). Specimens from Dr. C. B. Plowright, England. Spines few but stout, 15–25 by 6–8μ. The specimens in N. A. F. 918 have the pores a little smaller, the color inclining more to yellow and the spines rather more abundant. This species has very much the same general appearance as *M. salicinus* but the pileus is *tomentose* and rough.

TRAMETES PROTRACTA, Fr., and FOMES TENUIS, Karst. (specimens from Karsten), also have the hymenium thickly studded with long (30–40μ) spines and will be included in *Mucronoporus*. It may be noted that in all the species enumerated in this and the former paper the color of the hymenium is some shade of rust color or brown. We have not yet noticed any of the light colored species with the hymenium spiny. The same remark will apply to *Hymenochæte*.

NOTES.

By B. T. GALLOWAY.

ASCOSPORES OF THE BLACK-ROT FUNGUS AS AFFECTED BY COVERING WITH EARTH.

As is now well known the ascospores of the fungus causing black-rot of grapes are formed—at least in the majority of cases—during the spring and early summer months in the old berries which were affected the previous season with the disease. On the supposition that burying the old berries in the spring by turning them under with the plow will destroy the spores, many grape-growers go to considerable trouble and expense every year in order that this work may be done effectually. For the purpose of ascertaining just what effect covering berries, which

were known to contain the fungus of black-rot in various stages of growth, would have on the development of the parasite, but more especially to determine how long the fungus could live under such conditions, the following experiment was made by Col. A. W. Pearson, of Vineland, N. J. Old berries which had lain on the ground under the vines all winter were collected on the 10th of May, 1888, and immediately buried in loose garden soil at a depth of about 3 inches. On the 22d of April, 1889, I visited Colonel Pearson and together we uncovered the grapes, finding a goodly number of them apparently as sound as the day they were buried. With an ordinary magnifying glass the pustules of the *Læstadia* were easily made out, but of course a higher power was necessary to determine their contents. Accordingly some of the berries were brought to Washington, and on the 29th of April a number of careful examinations were made of them, but in not a single instance was a spore found.

The conceptacles were as numerous as in fresh specimens, but they were entirely empty. In a few cases some rather loose, broken down mycelium was seen passing through the tissues but it did not seem to be in a growing condition. It appears, therefore, that the fungus does not live for more than one year in the old berries providing the latter are buried beneath a few inches of soil and are subjected to ordinary conditions of weather. It is very probable that most of the ascospores escaped from the buried grapes the first summer, germinated as soon as they came in contact with the moist earth and quickly perished. We have undertaken a series of experiments this year for the purpose of determining, if possible, whether burying the old berries and removing the infected ones as fast as they appear has any material effect in diminishing the amount of rot, and if so, whether it will pay to do this work on a large scale.

THE GRAPE-LEAF BLIGHT.

In the eastern part of the United States, especially along the Atlantic coast south of Pennsylvania, the leaves of both cultivated and wild grape-vines are often attacked and frequently considerably injured by a fungus known as *Cladosporium viticolum*. Professor Scribner has described* and figured this parasite in his "Report on the Fungous Diseases of the Grape-Vine" under the name of the "Grape-leaf Blight," and in speaking of the possibility of its being only a stage of some higher form, says:

"What other spore forms there may be, or how the fungus passes the winter, remains to be discovered."

In May, 1888, we found, under a wild vine (*Vitis æstivalis*) near Washington, which was badly affected the previous summer with the *Cladosporium*, a number of leaves still showing the characteristic spots of the disease. Careful examination of these revealed the interesting

* Bulletin No. 2, Bot. Div.

fact that the fungus had survived the winter and was even then giving rise to immense numbers of spores. The latter did not differ from those formed throughout the summer, excepting that they were somewhat darker. The spores were sown in water and many of them germinated at the expiration of four hours, thus proving their vitality beyond question. Sections of diseased parts revealed the presence of a mycelium not differing to any great extent from that usually seen in growing leaves, excepting that here and there it was knotted together, forming somewhat globular, dark-colored masses, upon which the spores, together with their supporting stalks, were borne. The latter occur in compact bundles, and in our experiments it was shown that it is not uncommon for them to give rise to three or four successive crops of spores. It is very probable that the life of the fungus is in most cases preserved during winter by these bodies, and that the first warm days of spring are sufficient to start them into renewed growth and the consequent formation of spores.

A knowledge of the foregoing facts shows the importance of destroying the old leaves in the fall.

KANSAS FUNGI.

Profs. W. A. Kellerman and W. T. Swingle have just issued their first fascicle of Kansas Fungi, embodying twenty-five species neatly folded in papers, each accompanied by a printed label. The authors propose to issue a fascicle every two or three months, each of which will include about twenty-five specimens, made up of new species or those hitherto undistributed; also species occurring on new host plants. Only a limited number of copies will be issued, and if there are any left after their friends have been provided for they will be sold for \$1.25 per fascicle. The following is a list of the species and hosts of Fascicle I:

1. Æcidium æsculi, E. & K. On *Æsculus arguta.*
2. Æcidium dicentræ, Trelease. *Dicentra Cucullaria.*
3. Ceratophorum uncinatum, (Clinton) Sacc. *Carya amara.*
4. Cercospora cucurbitæ, E. & E. *Cucurbita perennis.*
5. Cercospora desmanthi, E. & K. *Desmanthus brachylobus.*
6. Cercospora lateritia, Ell. & Halsted. *Sambucus Canadensis.*
7. Cercospora seminalis, E. & E. *Buchloe dactyloides.*
8. Glœosporium apocryptum, E. & E. *Negundo aceroides.*
9. Glœosporium decipiens, E. & E. *Fraxinus viridis.*
10. Melasmia gleditschiæ, E. & E. *Gleditschia triacanthos.*
11. Microsphæra quercina, (Schw.) Burrill. *Quercus tinctoria.*
12. Peronospora arthuri, Farlow. *Œnothera sinuata.*
13. Peronospora corydalis, De Bary. *Corydalis aurea,* var. *occidentalis.*
14. Phragmidium speciosum, Fr. *Rosa Arkansana.*
15. Puccinia emaculata, Schw. *Panicum capillare.*
16. Puccinia schedonnardi, Kell. & Sw. *Schedonnardus Texanus.*
17. Puccinia (Leptopuccinia) xanthii, Schw. (*a*) *Ambrosia artemisiæfolia,* (*b*) *Ambrosia psilostachya.*
18. Ramularia virgaureæ, Thuem. *Solidago Canadensis.*
19. Roestelia pirata, (Schw.) Thaxter. *Pirus coronaria.*

20. SCOLECOTRICHUM MACULICOLA, E. & K. *Phragmites communis.*
21. SEPTORIA ARGOPHYLLA, E. & K. *Psoralea argophylla.*
22. SEPTORIA SPECULARIÆ, B. & C. (*a*) *Specularia perfoliata* (*b*) *Specularia leptocarpa.*
23. SPHÆROTHECA PHYTOPTOPHILA, Kell. & Sw. *Celtis occidentalis.*
24. UREDO QUERCUS, Bordeau. *Quercus macrocarpa.*
25. USTILAGO ZEÆ MAYS, (DC.) Winter. (*Euchlæna luxurians.*)

THE ASH-LEAF RUST (ÆCIDIUM FRAXINI).

This fungus was very abundant in the vicinity of Washington during the summer of 1887, occurring on large and small trees both in and out of the city. Last year (1888) it was comparatively rare, occurring only on small trees in the country, especially those growing along streams or in shady woods. At this time an attempt was made to germinate the spores. They were sown in water, moist air, and several culture fluids, but only in a few cases did they develop germ tubes. As a rule æcdiospores germinate readily when fresh, so that it is difficult to account for the non-success attending our trials. It would be interesting to know whether the spores of this fungus will germinate more readily in seasons when it is abundant.

TREATMENT OF GRAPE MILDEW MADE OBLIGATORY.

According to *Chronique Agricole et Viticole*, published at Lausanne, Switzerland, a decree was issued on May 4, 1889, making the treatment of vines for mildew obligatory. The decree provides that the Department of Agriculture shall give the necessary instructions, and unless these are complied with within the prescribed time the vines will be taken in hand by the authorities and treated at the expense of the owners. The owner for each offense will also be subject to a fine of not less than 10 nor more than 90 francs, this being equivalent to about $2 and $18, respectively.

DIORCHIDIUM TRACYI, DE TONI (PUCCINIA VERTI-SEPTA, TRACY & GALLOWAY).

This interesting fungus was discovered on a specimen of *Salvia ballatæflora* from New Mexico in the herbarium of the Department of Agriculture at Washington, and was described in the Journal of Mycology, Vol. IV, p. 21. As there are, so far as we know, only two meager specimens of this species in existence, we have thought best to illustrate it (Plate X, Figs. 3 and 4), so as to preserve its identity in case anything should happen to the specimens. The genus was established by Kalchbrenner in 1883,* and as it now stands contains five species as follows:

DIORCHIDIUM WOODII, K. & C., on *Melletia caffra* from South Africa.
D. BINNATUM, (B. & C.) De Toni, on unknown host from Nicaragua.
D. TRACYI, (T. & G.) De Toni, on *Salvia ballatæflora* from New Mexico.
D. PALLIDEUM, Winter, on unknown host from Brazil.
D. LEVE, Sacc. & Bizz., on *Manisurus granularis* from Brazil.

*(Grev., XI., p. 26.)

A NEW MODIFICATION OF THE VERMOREL NOZZLE.

In applying the Bordeaux mixture and other copper preparations with the Vermorel nozzle (Fig. 1) it often happens, especially after the pump has been used for some time, that the degorger A when pressed forward for the purpose of clearing an obstruction in the orifice B does not slip back of its own accord, and in consequence the liquid rushes out at C until it is checked by the operator reaching forward and pulling the rod down with his hand. To remedy this difficulty as well as to be able to suddenly stop and start the flow of liquid, which in certain kinds of work is often desirable, we have had constructed the nozzle and lance figured at 2 and 3. It will be seen that the spring C (Fig. 3) and the rod D are practically the same as those in use on the Raveneau nozzle figured and described in Bulletin No. 5 of the Section of Vegetable Pathology* Fig. 2 shows the modified nozzle natural size in section with the orifice G closed by the degorger E. The liquid entering the chamber at F is prevented from escaping at the back of the nozzle by the packing A, through which the degorger E works, and which is tightened by turning the screw of the stuffing box C. The brass spring D should not be fastened to the degorger E for the reason that it is often necessary to remove it so that the degorger may be cleaned and oiled.

Mr. A. L. Holladay, our agent located at Charlottesville, Va., has used the nozzle and lance for some time, and in answer to our inquiries as regards its work, says:

I like the apparatus better than any I have ever used. The spray being readily and quickly cut off, without putting the other hand to the lance, renders it convenient in passing from one row to another, or in passing around the end of a row. Then there is no danger of losing the cup at the end of the degorger and having the liquid squirted back in your face or upon your clothes. Best of all, however, I like the way the degorger springs back of its own accord. With the old nozzle, when the lance is pointed downwards, the degorger often slips forward and then instead of spraying in front the liquid shoots out behind, which is very annoying.

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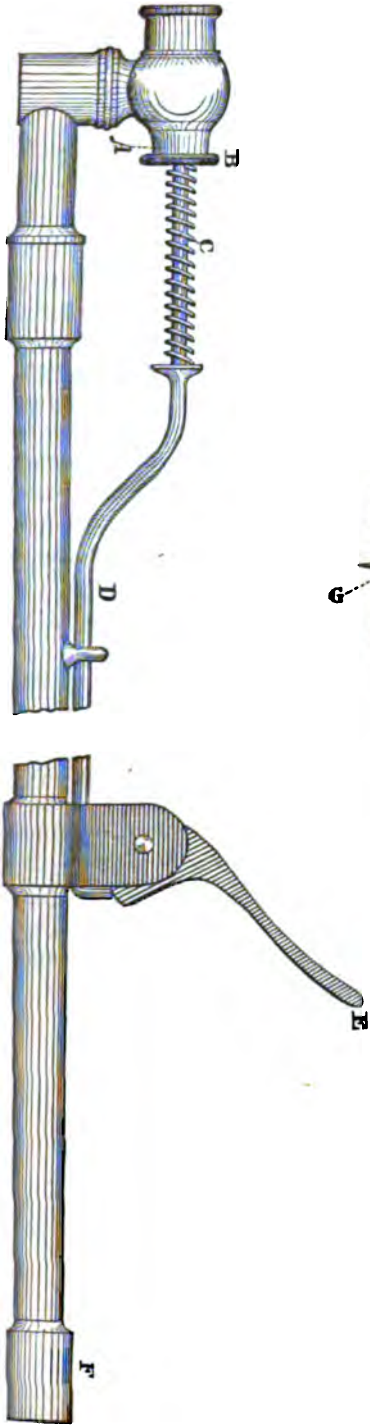
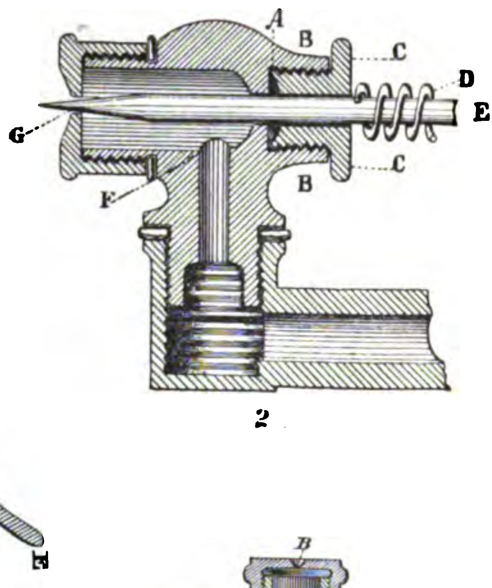
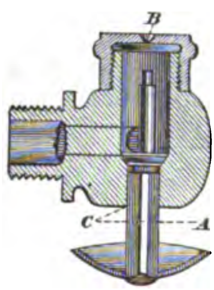
* P. 104.



3



2



1.

A NEW MODIFICATION OF THE VERMOREL NOZZLE.

REVIEWS OF RECENT LITERATURE.

BREFELD, OSCAR.—*Untersuchungen aus dem Gesammtgebiete der Mykologie. Fortsetzung der Schimmel und Hefenpilze von Oscar Brefeld.* Die Untersuchungen sind ausgeführt im Königl. botanischen Institute in Münster i. W. mit Unterstützung der Herren Dr. G. Istvánffy und Dr. Olav. Johan-Olsen. Quarto. Leipzig, verlag von Arthur Felix. 1888 and 1889. *Heft VII. Basidiomyceten II. Protobasidiomyceten*, pp. 178; 11 lithographic plates. Price 28 marks. *Heft VIII. Basidiomyceten III. Autobasidiomyceten und die Begründung des natürlichen Systemes der Pilze*, pp. 305; 12 lithographic plates.

Space forbids mention of all the interesting and important conclusions reached by Brefeld in these two volumes, which extend and complete Heft III, published in 1877. The work deserves and must everywhere receive the highest praise. A man of less heroic mold would never have undertaken, much less have carried to completion, such a stupendous work. It represents the labor of years, and sums up the critical study of over two hundred distinct species, distributed through about sixty-five genera and subgenera, each of which was grown in sterilized culture media from a single spore. The results of this study, if confirmed by others as in great part they undoubtedly will be, must lead to a number of important changes in classification, one of these being the reduction of the *Uredineæ* to a subordinate position alongside the *Auricularieæ* and *Tremellineæ* under *Protobasidiomycetes*, another being the recognition of the close relationship of the *Ustilagineæ*. Ptychogaster-forms are regarded simply as free-living *Ustilagineæ*, and the smuts must consequently be looked upon as reduced or undeveloped *Basidiomycetes*, destitute of pilei, stipes, etc., and restricted to the production of chlamydospores (smut spores). In like manner the Uredo- Teleuto- and Æcidio-spores of the *Uredineæ* are regarded as only so many forms of chlamydospores strictly comparable with those discovered in *Basidiomycetes*.

Nothing need be said here respecting Brefeld's methods, since they have been already generally approved, and are set forth substantially in Heft IV, only such modifications and improvements of methods there described being employed as time and experience showed to be necessary. It is sufficient to state that single spores were cultivated in suitable media and their growth followed uninterruptedly from germination to the production of fresh spores upon simple or compound sporophores. Many of these were under cultivation for months together, and so thoroughly successful were some of his cultures that by the use of larger and larger slides and by the addition of fresh nutrient material he was able to keep some species under observation

for a space of two years, in fact, until, as in case of *Dacryomyces*, they reached unmanageable dimensions. The following are some of Brefeld's conclusions:

The *Basidiomycetes* separate naturally into two divisions, *Protobasidiomycetes* with divided basidia, and *Autobasidiomycetes* with undivided basidia.

The forms of *Protobasidiomycetes* subdivide into three characteristic families. (See below.) The forms of *Autobasidiomycetes* include the *Hymenomycetes* and *Gasteromycetes* of earlier classifications.

The compound sporophore bearing the basidia is of non-sexual origin and nature.

There is no evidence of sexual reproduction in any stage in any member of this group.

The *Basidiomycetes* have been thought to be destitute or nearly so of pleomorphy. The actual case is quite the contrary. They are as much inclined to pleomorphism as any class of fungi, not excepting *Ascomycetes.*

In *Protobasidiomycetes* conidia are of almost universal occurrence. They are borne either on separate conidiophores, on coremia, or on conidial layers. Even pycnidia occur in *Craterocolla cerasi.* In certain cases conidia may also propagate by budding in yeast form *e. g.* species of Tremella. In *Autobasidiomycetes* conidia also occur, but are somewhat less frequent.

Aside from conidia there are other associate spore forms, the peculiar Chlamydospores. In simplest form they occur as the well-known "oidia," but they also appear in other and higher forms which occur either singly or in masses like sporophores or like conidiophores. These Chlamydospores have not yet been found in *Protobasidiomycetes*, but in most families of *Autobasidiomycetes* are very widespread in Oidium form, less common under more highly developed forms. In some instances entire mycelia assumed the Oidium form and propagated repeatedly like "*Oidium lactis*," nor could the author induce them to assume any other form by artificial cultures in nutrient solutions. In the genera *Nyctalis*, *Fistulina*, and *Oligoporus* (Ptychogaster) highly developed chlamydospores are particularly abundant.

The discovery of these associate spore forms gives a peculiar character to this whole class of fungi and is extremely important in a morphological sense, not only for the arrangement of the several portions of the class, but also as determining its relations to other classes. Heretofore the basidia and basidiospores were of small value morphologically. They could not be compared with any other spore form. The conidia are the most essential for comparison. The chlamydospores are non-sexual intercalary forms. For the explanation and understanding of the basidia and *Basidiomycetes* they are of no importance.

The basidia are also conidiophores, but with this distinction, they

have become specialized and stand on a higher level morphologically; or, as Brefeld puts it:

> ***The conidiophore as a basidium*** has become typical and regular in form and segmentation and especially in number of spores; ***the conidiophore, in the narrower meaning of the word*** stands upon a lower level; it has not yet reached this typical regularity of form and in connection therewith the definite number of spores; in both it oscillates continually and, influenced by suitable conditions, is large or small, is thickly covered on its top with spores, or poor in spores, or reduced sometimes even to a single spore.

From this and following statements it is clear that Brefeld considers the compound sporophores of *Hymenomycetous* and *Gastromycetous* fungi as evolutions from earlier and simpler conidial forms, many of which still persist. The impossibility of deriving all these forms from one primitive stock is so apparent that he writes with a grim delight:

> Wo bleibt nun hier die Systematik de Barys, etc.

and again more severely:

> Diese Systematik hat höchstens noch den Anspruch, als ein Beispiel fort zu bestehen, welches lehrt, wohin blosse Deductionen in der Systematik führen, wenn sie nicht auf dem Boden der vergleichende Morphologie stehen.

The reader will be interested in comparing Brefeld's scheme of classification here reproduced with that given by De Bary in his *Morphology and Biology*, English ed., p. 132, German ed., p. 142:

Natural system of the filamentous fungi.

- **Phycomycetes (lower, algæ-like, sexual fungi).**
  - I. Class *Zygomycetes.* Sexual reproduction by Zygospores.
    - Non-sexual propagation.
      - By sporangia only. (*) — Mucorini. Thamnidiæ (†).
      - By sporangia and conidia. (**) — Choanephoreæ (†).
      - By conidia only. (††) — Chætocladiaceæ (†). Piptocephalideæ.
  - II. Class *Oömycetes.* Sexual reproduction by oöspores.
    - Non-sexual propagation.
      - By sporangia or conidia. — Peronosporeæ. Saprolegniæ. Chytridiaceæ.
      - By conidia only. — Entomophthoreæ.
- **Mycomycetes (higher, non-sexual fungi).**
  - Ustilagineæ. Intermediate forms.
    - Propagation.
      - By sporangia (*) resembling asci. — Protomyces (provisionally one genus only.)
      - By conidia resembling basidia. (††) — Ustilago, Tilletia Sorosporium, etc. (the remaining forms of the smut fungi).
  - I. Class *Ascomycetes.* Propagation by sporangia and conidia. (**) Sporangia in asci.
    - Exoasci (asci naked). — Exoascus, Taphrina (provisionally only these two genera).
    - Carpoasci (asci in compound fruit-bodies). — Tuberaceæ. Pyrenomycetes. Discomycetes (the characteristic mass of Ascomycetes) with their subfamilies.
  - II. Class *Basidiomycetes.* Propagation by conidia only. (††) Conidia borne on basidia.
    - Protobasidiomycetes. (Basidia divided).
      - Gymnocarpous. (‡) — Uredineæ. Auriculariæ. Tremellineæ.
      - Angiocarpous. (¶) — Pilacreæ.
    - Autobasidiomycetes. (Basidia undivided.)
      - Angiocarpous. (¶) — Lycoperdiaceæ. Nidularieæ. Phalloideæ. Hymenogastreæ.
      - Hemiangiocarpous. — Thelephoreæ. Hydneæ. Polyporeæ. Agaricini.
      - Gymnocarpous. (‡) — Dacryomycetes. Clavarieæ. Tomentelleæ.

The asterisks, etc., denote genetic kinships, indicated in Brefeld's table by connecting lines.

The general observations of Heft VIII are completed by two very interesting chapters on (1) *The Morphological Value of Chlamydospores in Fungi* and on (2) *The Morphological Value of Conidia in Fungi.* There is also a sort of appendix on *The importance of light for the development of certain fungous forms.* The conclusion of the latter is that, in the fungi which were examined (*Pilobolus*, *Coprinus*), light has no influence, on sterile mycelial growths, but that it is absolutely essential to the

normal development of the primordia and the compound sporophores. the blue-violet end of the spectrum being the only stimulating portion. In many cases the mycelia remained absolutely sterile when kept in darkness or when exposed only to yellow light.

In his preface to Heft VII the indefatigable author promises to return to the smuts in Heft IX and to the *Ascomycetes* in X and the following Heften. We trust he may be spared life and daylight to the completion of his great task, the material for which he tells us is already in good part accumulated and only remains to be put into proper shape.—ERWIN F. SMITH.

MIYABE, KINGO. *On the life history of Macrosporium parasiticum*, Thüm. Annals of Botany, February, 1889.

The investigations, the results of which are set forth in this paper, were carried on at Harvard University under the direction of Dr. Farlow, the material for study, consisting of onion plants, having been sent to him from Bermuda. Without going into the details of the work it may be said that Mr. Miyabe concludes that *Macrosporium parasiticum*, Thüm., is the same as *Macrosporium sarcinula*, Berkeley, and that both of these so-called species are merely forms of the common *Pleospora herbarum*. He further shows that there are only two forms of the *Pleospora*, *i. e.*, the *ascosporous* and the *Macrosporium*, and remarks in his recapitulation that the presence of pycnidia is very doubtful, and may have disappeared from the fungus cycle of development altogether. It is shown that the formation of the perithecia is not attended by any sexual act, and finally that the *Macrosporium*, contrary to the usual belief, is a true parasite, having power of developing within the tissues of plants not previously injured by fungi or other causes.—B. T. GALLOWAY.

LAGERHEIM, G. *Ueber einige neue oder bemerkenswerthe Uredineen.* Hedwigia Band XXVIII, Heft 2, p. 103.

In this paper are given the results of some recent observations on several genera of *Uredineæ*, the first of which is *Diorchidium*. This genus, according to the author, was established by Kalchbrenner in 1883 from specimens occurring on *Milletia caffra*, collected at Port Natal, South Africa. It differs from *Puccinia* in having teleutospores divided by perpendicular or oblique instead of horizontal cross-walls. Soon after the attention of mycologists was directed to this peculiar genus, new species were found, the first among these being *Diorchidium læve*, Sacc. & Bizz., on *Manisurus granulis* from Brazil, and *Diorchidium pallidum*, Winter, on an undetermined host plant from the same place. Later, De Toni in Sylloge VII, p. 736, referred *Triphragmidium binatum*, Berkeley, on an undetermined host plant from Nicaragua, and *Puccinia verti-septa*, Tracy & Galloway, on *Salvia ballatæflora*, from New Mexico, to the same genus. In the case of *D. pallidum* and *D. verti-septa* uredo-

spores were described as occurring with the teleuto form, but of the remaining three species only the latter stage was observed. In one of these, *D. læve*, S. & B., on *Manisurus granulis*, the author has recently discovered the uredo form, which he describes as occurring abundantly on both sides of the leaves. The sori are scattered and give to the surrounding parts a reddish or yellowish hue. The spores are roundish or ovate, 24–30μ in diameter, and are more or less spiny. Teleutospores of this species were very scarce. They are roundish or ovate, greatly enlarged at the apex and often somewhat concave. The author concludes his remarks on this genus by saying that it is certainly closely related to *Puccinia*, the only difference, so far known, being the position of the septum, which is never constant.

Following the foregoing observations are notes on a new variety of *Puccinia Schneideri*, Schrœt.; *Puccinia rubefaciens*, Johans.; *Puccinia silphii*, Schw.; *Puccinia Seymeriæ*, Burr.; *Puccinia ribis*, D. C.; *Puccinia oxyriæ*, Fckl.; *Uromyces Holwai*, *n. s.*; *Uredo arcticus*, *n. s.*, and *Cæoma nitens*, Schw.

Uromyces Holwai was collected at Ann Arbor, Mich., by Mr. E. W. D. Holway on *Lilium superbum*. Both the uredospores and teleutospores occur at the same time, appearing on both sides of the leaf. The Æcidium was not found. The uredospores are roundish, spiny, and are 20–26μ in diameter. The teleutospores resemble in every respect those of *U. ery hronii*, (DC.), excepting that they are of a somewhat lighter color and have a thicker apex. In speaking of *Cæoma nitens* the author cites the opinion of several writers as to the probable connection of this fungus with other *Uredineæ* occurring upon *Rubus*, concluding his remarks by a reference to Allescher's paper, published in Bot. Centrablatt, No. 48, 1888, in which it is shown that the *Cæoma* is an isolated form.—B. T. GALLOWAY.

PLOWRIGHT, CHARLES R. *A Monograph of the British Uredineæ and Ustilagineæ.*

The appearance of this book was gladly welcomed by American botanists, although it does not deal with distinctively American species. It fills a need long felt by workers in this special field by combining in a convenient form the history, biology, morphology, classification, and economics of the rusts and smuts. The economic features are not directly treated in detail, but every portion abounds in notes and suggestions that can be applied to this phase of the subject, and the chapter on infection bears directly upon it.

The first part of the book comprises chapters on the biology, mycelium, spermogonia, æcidiospores, uredospores, teleutospores, and heterœcism of the *Uredineæ*; on the mycelium, formation of the teleutospores, and germination of the teleutospores of the *Ustilagineæ*; on infection of host plants by the *Ustilagineæ*; spore culture, and artificial infection of plants.

The object of the book, the author says, "is to obtain an insight into the life history and structure of the species of parasitic cryptogams occurring in Great Britain."

In the chapter on spermogonia considerable attention is paid to the attractions offered to insects by the saccharine qualities and odor of the spermogonia themselves and the bright color of the spots on which they are produced. A large number of experiments on the germination of spermatia were made, and the author succeeded in germinating the spermatia of the æcidia on *Bellis perennis*, *Ranunculus bulbosus*, *R. ficaria*, *Anemone coronaria*, *Lapsana communis*, and some others, but he did not succeed in infecting healthy plants. He discovered important differences between the budding spermatia and true yeast spores, in that the former did not produce alcohol. The function of the spermatia is discussed at some length, and the author concludes that the balance of evidence points to the conclusion that the spermatia are not sexual organs, but may possibly be conidia.

An important item in the chapter on æcidiospores is the fact that Plowright could not induce them to germinate after forty-eight hours, contrary to De Bary, who states that they retain their germinative faculty for some weeks.

Under Uredospores he notes the production of sporidia when the germ tube can not enter a stoma, and discusses the significance of paraphyses occurring with the uredospores. He considers them as morphologically analogous to the pseudo peridial cells of the æcidiospores, and says that when uredospores do not arise directly from the æcidiospores they are constantly present, but hardly present at all when the uredospores arise directly from the æcidiospores. He thinks that this indicates that they are an indication of exhaustion of vital energy, which is combated by protective efforts on the part of the fungus in preserving the spores it does produce.

Considerable space is devoted to the influence of barberry bushes on wheat and to the development of the knowledge of the heterœcism of the *Uredineæ*. The latest results on the subject are given in a tabular statement which may be summed up as follows: Forty-seven teleutospore forms have been connected with their corresponding æcidia. Of these Plowright himself has established the connection in eleven cases and verified it in twenty-seven others.

The *Ustilagineæ* are dealt with in essentially the same manner as the *Uredineæ*. After a short chapter on the mycelium, the author devotes a much longer one to spore formation, which he describes in detail for each genus. The chapter on germination includes descriptions of germination in all the different genera, together with fifteen species of *Ustilago*, five of *Urocystis* and three of *Entyloma*.

The chapter on Infection of Host Plants by the *Ustilagineæ* is devoted to discussing as to when and where the germ tubes of *Tilletia tritici* and *Ustilago segetum* enter the young plant; while this has been practically

settled for the former, Plowright's experiments with the latter have only brought forth negative results. The chapter has a very practical application in that the decision of the question decides the best method to be followed in dressing seed to prevent smut. The fact that the question has been decided in case of bunt has enabled farmers to practically avoid it by a little exertion.

The chapters on spores culture and artificial infection of plants had perhaps been anticipated as eagerly as any by practical workers, and, while we could wish they had been longer, they are full of valuable suggestions.

The descriptions of species are full and accompanied by lists of synonyms, exsiccati, dates of appearance and disappearance, and biological notes. Plowright follows Winter in his method of citing authority. Where there is a double citation he retains the original authority in parentheses and omits the other. He has also followed Winter's classification, but has introduced the *Brachyuromyces* and *Brachypuccinia* to cover those forms having spermogonia, uredospores, and teleutospores. There are no *Uromyces* corresponding to this division, but the following *Puccinias* are included under it: *Puccinia suaveolens*, *P. bullata*, *P. hieracii*, *P. centaureæ*, and *P. taraxaci*. Winter places the first two under Hemipuccinia and includes *hieracii* and *taraxaci* under *P. flosculosorum*, one of the Antepuccinias.

In *Phragmidium* Plowright omits any subdivisions, but in *Melampsora* he departs entirely from Winter's arrangement and gives the following:

I. *Melampsora*. Teleutospores formed outside the epidermal cells of the host plant, and remaining single.

II. *Pucciniastrum*. Otth. Teleutospores formed outside the epidermal cells, becoming longitudinally or obliquely divided into from two to four cells.

III. *Thecopsora*. Magnus. Teleutospores formed in the epidermal cells, becoming confluent into irregular circumscribed masses. Uredospores in pustular heaps.

IV. *Melampsorella*. Schrœt. Teleutospores undivided, formed inside the epidermal cells (intracellular), hyaline, confluent in wide-spreading masses. Promycelial spores hyaline. Uredospores echinulate, inclosed in a pseudoperidium.

Coleosporium and *Chrysomyxa* are subdivided in the same manner as *Uromyces*.

There is a supplement containing a description of species of the related genera, *Graphiola*, *Entorrhiza*, *Tuberculina*, and *Protomyces*.

The book also contains a copy of the Massachusetts barberry law and a glossary, and is well indexed—E. A. SOUTHWORTH.

PRILLIEUX, M. *Maladie des Feuilles des Pommiers et Châtaigniers en 1888.* Society Mycologique de France, Tome IV, p. 143.

In this paper the author gives an account of two very destructive diseases which prevailed among apple and chestnut trees in several parts of France in 1888. The diseases are caused by parasitic fungi, and in case of the apple the fungus makes its appearance about the last of August and develops rapidly during the month of September. The disease is first manifested by a shriveling of the leaves, which quickly turn brown and fall, leaving the limbs entirely bare long before the proper time. Careful examination of the affected parts reveals the presence of the body or mycelium of the fungus growing in the tissue, and further manipulations show that at certain points just beneath the epidermis it is massed together, forming dark-colored sclerotia-like bodies. From these arise the conidiophores, which bear upon their tips the spores or reproductive bodies; these are usually oblong, occasionally one-celled, but more often divided by one or more transverse partitions. The mycelial filiaments also occur abundantly on the surface, forming numerous little dark-colored bodies similar to those produced beneath the epidermis. M. Prillieux places the fungus in the genus *Cladosporium* and states that it is closely related to *Cladosporium herbarum* var. *fasiculare.*

Besides the *Cladosporium* there is also produced on the same spots conceptacles of two sizes and kinds, the smaller ones being a *Phoma*, the larger certainly the perithecia of a sphæriaceous fungus having the asci only partially developed. Nothing is said in regard to the probable connection of the foregoing forms, but in concluding his paper the author remarks that leaves containing the perithecia have been placed where the future development of the fungus can be studied.

In speaking of the chestnut disease the author says that the fungus attacks the leaves, frequently injuring them to such an extent that none of the fruit matures. The leaves, when first attacked, show here and there on the surface little brown dots, which soon run together, forming larger blotches. Ultimately the leaves fall to the ground and perish. The withered spots are covered on the under side with the black conceptacles of the fungus, and in these the reproductive bodies are formed. The fungus appears to be the same as that described in Saccardo's Sylloge, Vol. III, p. 35, under the name *Phyllosticta maculiformis*, Sacc. This fungus is believed to be a form of *Sphærella maculiformis*, but so far as known their relationship has not been proved. The author closes his remarks by saying that the great damage to the chestnuts by the parasite the past season is probably owing to the exceptional humidity of the atmosphere throughout the entire summer. He further states that the only means of controlling the disease which a knowledge of the facts in the case suggests is to gather the leaves in the fall and burn them.—B. T. GALLOWAY.

THÜMEN, FELIX VON. *Die Bekämpfung der Pilzkrankheiten unserer Culturgewächse.* Versuch einer Pflanzentherapie zum praktischen Gebrauche für Land- und- Forstwirthe, Gärtner, Obst- und Weinzüchter. Verlag von Georg Paul Faesy, Wien, 1886, paper, 8vo., pp. 157.

This modest little volume is a move in the right direction, and deserves more attention than it appears to have received in this country. In a brief and interesting manner, albeit not in very choice German, the author describes some of the more destructive fungous diseases of orchard, garden, field, and forest, and states concisely the best methods of dealing with this class of diseases. In reading, however, one is especially struck by the advance which has been made in the treatment of the vine mildew, *Peronospora*, since 1885, when the author wrote: "A favorable result is not to be expected from any fungicide; up to this time at least all proposed remedies have proved totally inadequate, or at least impracticable on a large scale."

Thirty-five distinct diseases are included, distributed as follows: 13 on field crops, 10 on fruit and garden vegetables, 6 on the vine, and 6 on forest trees.

In the introduction, which to the general reader is, perhaps, the most interesting portion, Professor von Thümen discusses those special conditions which, in his judgment, favor the increase of this class of diseases. They are:

(1) The accidental introduction of foreign parasites (*Einschleppung*).

(2) The almost universal neglect of field hygiene, meaning by this the destruction of neighboring wild plants, etc., which might harbor injurious fungi.

(3) The growth of one crop repeatedly (*Hypercultur*) whereby every opportunity is given for the excessive multiplication of parasites.

(4) Propagation by unnatural methods, *i. e.*, by layering, budding, grafting, etc.

(5) The ever-increasing business intercourse and movement of population.

It is apparent from these statements that the author believes the control of this class of diseases lies largely in the hands of the cultivator. He should guard against foreign enemies; he should carefully destroy weeds, etc., likely to harbor parasitic fungi; he should practice rotation of crops; he should return as much as possible to varieties raised from seed, and, finally, he should keep a sharp watch lest enemies be introduced from neighboring localities in unsuspected ways, *e. g.*, with goods, seeds, grains, vines, etc.

His remarks on "the root-mould of the grape-vine" appear of sufficient interest to be reproduced in full, especially in view of the possibility that the mysterious and destructive vine disease of California may be due to some similar parasite.

"Within a few years—about six or eight—numerous complaints have

come from the vine districts of the most different lands about a so-called mysterious disease to which single vines or larger parts of the vineyard have fallen victim. Without visible cause stocks here and there in vineyards which have stood for decades or centuries in good cultivation and sound growth begin to be sickly, their leaves become yellowish, then withered and drooping, their ends and edges growing brown; end shoots and other young shoots dry up, and, in many cases, the whole aspect gives exactly the impression that the vineyard has been attacked by the vine-louse. At other times there occurs in the vine generally only an extremely slight vegetative activity, as one may readily observe if he passes through the vineyard in May or in the early part of June. Then we notice that the stocks attacked by the "mysterious" disease have developed only a very few short shoots, and these bear scanty, small leaves, and a few short abnormal-looking small clusters. Finally, we also meet vines with foliage of a peculiar green, difficult to describe, and on which a marked shortening of the internodes is especially striking, giving to the affected stock a bushy appearance which, in connection with a not very considerable but yet clearly visible crinkling (*krauselung*) of the leaves, has given to the affected stocks (in lower Austria) the common name ("*Kraupet*") frizzles (?).

A scrupulous examination of the roots shows that no vine-louse is at the bottom of this trouble; moreover no other insect, at least no abundantly appearing parasite, is present to which one might, perhaps, ascribe the sickening of the plants. Just as little can we find on the withering or dead leaves or shoots any fungous growth whose action has caused the sickening of the vine. It therefore happens in very numerous instances that the experts, practical or theoretical, who have been drawn thither stand helpless in face of the disease. It may be accepted as certain, moreover, that this disease is in no sense a new one, but that it has existed for a long time, although it probably formerly appeared much more rarely, and in consequence was overlooked and not considered. For a long time this described appearance has been known to vine-growers in France and Switzerland, and given them much concern. There, also, they got pretty well on the track of the symptoms of the disease, although many of the views, assertions, and explanations there published lack all permanency and scientific basis.

There is no doubt that the sole and only seat of the disease is to be looked for in the roots of the vine, and therein exactly, as well as in its extraordinary invisibility, is to be found the reason why the peculiar cause of the malady remained so long unknown. A fungus extremely invisible and easily overlooked, or more strictly a sterile fungous growth, is the cause of the sickness and death of the vine. If we examine minutely the roots of those vines which show some of the symptoms described in the beginning, we shall observe first of all a strikingly small number of fibrous and dependent roots, often, indeed, their entire absence; and further, we shall see on those still present, as well as on the

larger main roots, very delicate, fine, almost cob-web-like, white, fungous threads, which are abundant or scanty, conspicuous or with difficulty demonstrable, and which cover and overgrow the organ in many places, and sometimes even spin all around it. The great fragility and tenderness of these growths is, however, also the reason that they are so easily torn off and destroyed in pulling the vines out of the earth. On this account, for the more certain demonstration of the trouble, it is requisite that the removal of the vines be effected with special care and exactness. This fungus does not possess any organs of fructification, but consists entirely of very thin, hyaline, cylindric-tubular threads or hyphæ, septate at long intervals. It is nothing but a so-called sterile mycelium. Although the scientific identification and naming of such sterile forms is beset with great difficulty, still, without special violence, we can identify the root-mould of the vine with the growth *Fibrillaria xylotricha*, described by Persoon.

Similar sterile mycelia, which, in essential particulars, at least, do not depart from those on the roots of the vine, are found everywhere on decaying twigs and branches of deciduous and coniferous trees, as well as on all sorts of decaying wood lying below the earth's surface; finally also on the roots of very different plants, in short, wherever woody parts begin to decay. If, for example, in a shady forest we examine a heap of broken-off, withered branches or a pile of limb-wood, we very soon observe, as we throw it somewhat apart, that the whole mass is penetrated in all directions, in case it has remained undisturbed some weeks, by fine, hyaline, thin and delicate threads. Almost every single small branch is woven and spun over; and the moister the locality the more restricted the access of air, so much the more compact is the weft, so much the more numerous are the threads.

But this observation here communicated puts us at once on the right track; it shows us a parasite injurious to vine growing, but on the other hand gives us the method by which we can protect our plantations from its attacks. In like manner, as into the small branches and twigs, the encircling, thin, fungous threads penetrate into the roots of the vine, the tissues of which they disintegrate, first those of the outer bark, then, later, pushing steadily inward, they ramify between the wood cells, brown these first, and then bring them quickly to destruction, and thereby progressively the whole organ into decay. It is evident that the thinner and weaker roots first suffer the attacks of the invisible, but not on this account less dangerous, enemy, and this is why, as already emphasized, we find the diseased vine when lifted out of the ground almost wholly denuded of horizontal (*thau*) and fibrous roots, and entirely dependent upon the main roots for nourishment. For this reason, the sickening and decay of the plants, the main roots alone not being able to perform the function of sustenance.

If the subsoil of the vineyard is unduly impervious while the surface soil is very loamy and clayey, then the excessive wet, so hindered from

running off or settling down, causes easily of itself, as it stagnates, a growth of fungous mycelia, and the roots of the vine have accordingly to suffer from it in the way described. For overcoming such conditions we shall have to bring into use various methods adapted in each case to the local conditions, *e. g.*: drainage, thorough loosening and aerating of the soil. earth mixture by carting on sand, contingently also the addition of gypsum.

But in the greater number of cases man himself is the guilty party—the keeping clean of the soil being only too often grossly neglected. Upon the surface, indeed, the industrious and methodical vineyardist does not fall into error so easily, since several times a year the entire vineyard will be cut over (*behauen*) and carefully weeded by hand or by the plow. But this alone does not long suffice; the deeper portions of the soil must also be carefully cleaned, and this unfortunately is almost everywhere slighted, probably entirely neglected. If the branches and twigs lying in the open air form a most favorable soil for those tender, white, fungous threads, how much more must the same objects further their growth when buried deep in the earth where the air supply is so much more scanty. All wood fragments occurring in the soil figure as the most important spawn ground of such mycelia—and such fragments are never absent from the vineyard.

In the removal of old or dead vines, in intrenching (*vergruben*), etc., numerous root fragments always remain in the earth; in grubbing and hoeing (*behauen* and *hacken*) such are easily cut off; in pulling out vine palings in autumn numerous pointed ends are broken off and remain in the soil; enough wood fragments are accidentally introduced into the vineyard with the stable manure; dead twigs fall from the fruit trees frequently planted in the vineyard, or prunings occasionally remain; or pieces of roots are easily cut off in working the soil; or wood may be introduced in various other accidental ways. But we also bring many sorts of wood into the vineyard directly, especially where the objectionable custom prevails of burying deciduous and coniferous brushwood for the loosening and improvement of the soil. The described mycelia develop most luxuriantly upon all these various wood fragments—indeed, frequently enough such fragments are entirely covered with the mycelia, even before the wood is buried, and their migration to the roots of the vine and the infection of the latter is only a question of time.

But the causes of the root mould here described give at the same time a correct indication for the satisfactory treatment and banishment of this destructive disease. We have already spoken of a gradual improvement of the soil and drainage, but in addition the most punctilious preservation of the vineyard soil from all wood is the most certain means of protecting it from the root-mould. Again, it must be insisted on strongly that in pruning the vines the workman shall carefully gather and remove all the separated shoots, so that nothing whatever

shall remain lying about in the vineyard. Likewise in hewing must all resulting wood fragments be scrupulously gathered and immediately removed. All stocks once attacked by the disease must be pulled out and burned as soon as possible—all still existing roots, with the very utmost speed. Finally, moreover, care must be taken in the removal of vine stakes at the beginning of the winter that the points, sometimes broken off in this way, are not left in the ground. Were it in general practicable, from local or pecuniary reasons, to remove the vine palings entirely and substitute cultivation upon wires, then certainly one chief source of infection would be entirely removed. In conclusion, it may also be mentioned that where persons do not feel able to do without forest litter in the cattle stables and the use of the resulting manure in the vineyard, a frequent scattering of Stassfurt fertilizer or kainit in the stables and on the dung pile will result in good, as thereby, the beginning of this fungous mycelia will be hindered."

Three other underground parasites are considered—*Phasmodiophora*, *Dermatophthora necatrix*, and *Rosellina quercina*; but no mention is made of *Agaricus melleus* or of Hartig's *Trametes radiciperda*, which Brefeld now says (VII, p. 14) should unquestionably be referred to *Polyporus annosus*, Fr.—Erwin F. Smith.

DESCRIPTION OF PLATES.

Plate IX (after von Tavel).

Glœsporium nervisequum.

Fig. 1. Cross-section through a vein and pustule of the fungus; the basidia are only partially drawn. The abscision of spores has not yet begun. x 380.

2. Spores. x 380.

Fenestella platani.

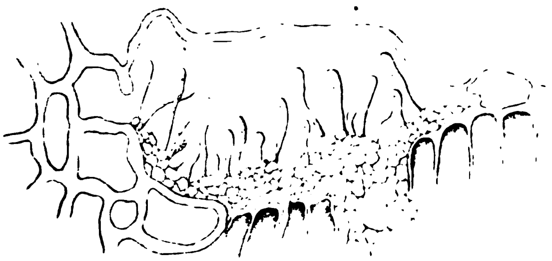
3. Cross-section through a young stage. The representation of the host plant is diagrammatic. x 128.
4. More advanced stage. x 128.
5. Same mature. The spore mass is only indicated. x 80.

Plate X.

Fig. 1. *Langloisula spinosa* mycelium. E. A. Southworth, del.

2. Spores. E. A. S., del.
3. *Diorchidium Tracyi*, uredospores. E. A. S., del.
4. Teleutospores. E. A. S., del.
5. *Septosporium heterosporum*, tuft of conidia. After E. A. S.
6. Spores. After E. A. S.

1.



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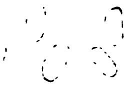

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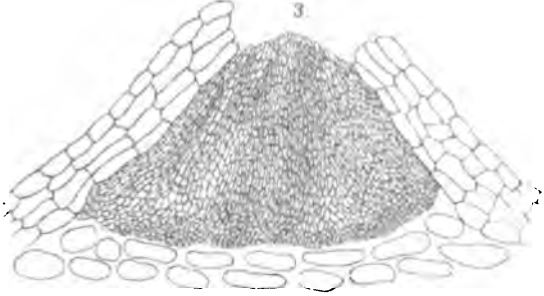

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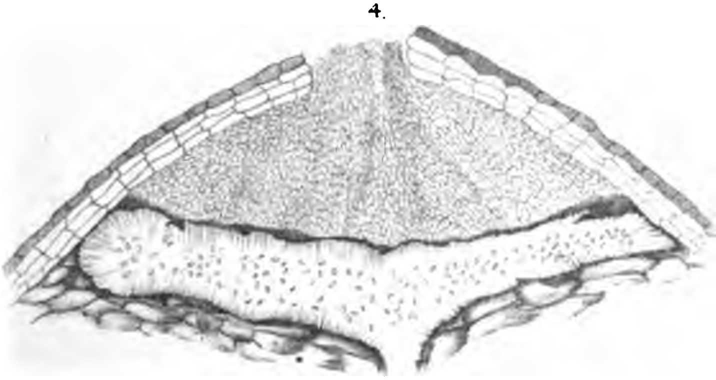
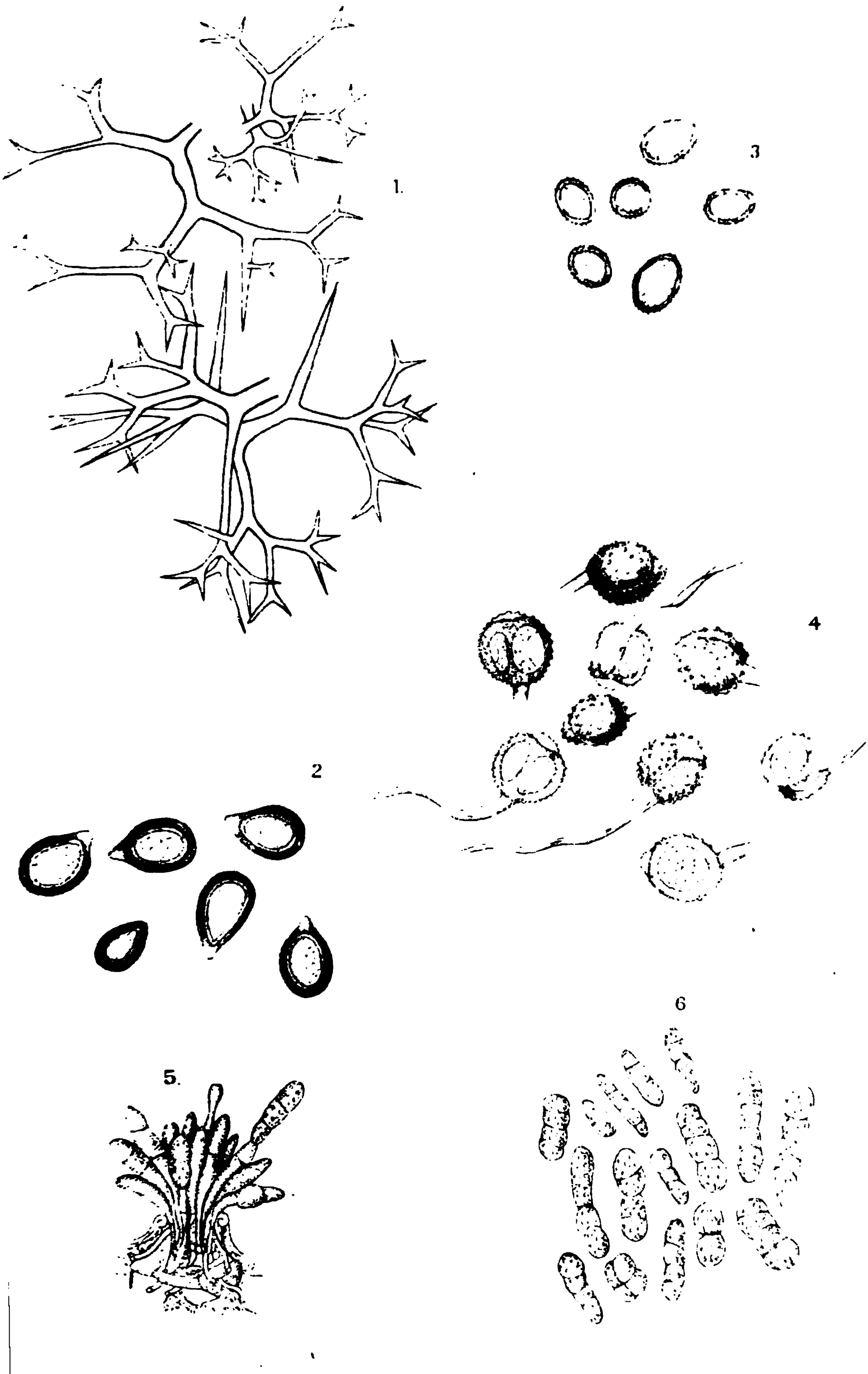


5.

VON TAVEL ON DEVELOPMENT OF THE PYRENOMYCETES.



NEW SPECIES OF FUNGI.

U. S. DEPARTMENT OF AGRICULTURE.
SECTION OF VEGETABLE PATHOLOGY.
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THE JOURNAL OF MYCOLOGY:

DEVOTED TO THE STUDY OF FUNGI,

ESPECIALLY IN THEIR RELATION TO PLANT DISEASES.

BY

B. T. GALLOWAY,
CHIEF OF THE SECTION.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1889.

CONTENTS.

CONTRIBUTIONS TO THE HISTORY OF THE DEVELOPMENT OF THE PYRENOMYCETES.

(Plate XI.)

By FRANZ VON TAVEL.

[*Continued from page* 58.]

III. FENESTELLA PLATANI, *n. s.*

Several dry branches of *Platanus* attacked by *Discula platani* and two forms of *Cytispora* were placed in moist air and left to themselves. It was the end of October before the observations could be taken up again. The *Cytispora* forms were still present, and between them protruded a number of long black necks of the perithecia of a Pyrenomycete not described in any of the systematic works which we used. It was, therefore, very minutely examined; its development could not, of course, be followed out completely, but it yielded some noteworthy results.

The starting point of the investigation was, as has been said, a form of *Cytispora*. The great variability of this form makes it doubtful whether or not it is identical with *C. platani*, described by Fuckel, E. F. N., No. 334. While still in the younger stages *Cytispora* shows itself on a branch in the form of small swellings 1–3 millimeters in diameter. The bark soon ruptures and the well known worm-shaped masses, which here have a waxy-yellow and often a whitish color, project through the openings. Upon removing them a black body, the stroma, may be seen through the crack in the bark. The stroma continues to increase in size, making the opening in the bark wider and then projecting through it. In the meantime new spore-masses protrude. The branches were kept in tall cylindrical jars containing some water at the base. It was apparent that the largest stromata existed at the base of the branches while the fungus developed very sparingly at the tips. It seems, therefore, that a high degree of moisture promotes the growth of the fungus. Fully-developed specimens of *Cytispora* often attain a diameter of one-half a centimeter; ten spore-masses may project from the stroma at the same

are parallel to its long axis and which, diverging on the surface, clothe it with a kind of felt. The hyphæ on the inside which line the neck canal also bend outward and form hairs. These are all directed obliquely upward so as to permit the escape of the spores but to guard the entrance to the perithecium. In the older as well as the earliest stages the inner wall is composed of a colorless thin-walled pseudoparenchyma, and surrounds the entire cavity of the perithecium with the exception of the neck. The origin of this cavity and of the neck canal can not be definitely decided. The paraphyses and asci arise from the inner wall; the former are present in large numbers and are very long, slender, and thin walled. Their contents consist of finely granular protoplasm containing many globules that reflect the light.

In their earlier stages the asci are composed of extremely delicate club-shaped cells filled with strongly refracting protoplasm. Their wall remains very delicate even when they are fully grown. The form of the mature ascus is that of a cylinder, obtuse at the upper end and suddenly contracted below into a short, slender pedicel. It contains eight spores, which are oval, dark-brown, and three-septate at maturity. The two middle cells are each again divided by an oblique wall, which disappears when the spore is turned through an angle of 90° (Fig. 6). Very rarely there are a greater or less number of cell walls than stated above. The spores are slightly constricted in the planes of the septa, and the whole is surrounded by a thin, gelatinous layer. The length of the spore averages 14–18μ, the diameter 5–9μ.

The details of the perithecium having been fully examined, the point has been reached when the systematic position of the fungus should be more thoroughly considered. The main points upon which this depends are the following: The brown spores with their longitudinal and transverse septa; the presence of paraphyses; the existence of a stroma, if only an imperfectly developed one, which is certainly Valsoid, as is proved by the fact that it is very small in circumference and has perithecia projecting from the center and pycnidia from the circumference (Fig. 7). Of all known genera *Fenestella* is the only one which can be considered, since it is characterized by the above-mentioned points. Besides, there is no reason why the fungus should not be placed in this genus. It should be mentioned, however, that in most species of *Fenestella*, especially the native species *F. princeps*, the spores have many more septa; yet Saccardo mentions those having but few. This species differs from all other *Fenestellæ* in the great development of the neck, which gives it the appearance of a *Valsa*, and when the color of the spores is taken into consideration it stands very close to a *Pseudovalsa*. It may therefore be decided, merely on account of the longitudinal septa (which, as stated above, are visible only in a certain position of the spore) that it should be classified not as a *Pseudovalsa* but a *Fenestella*. Although the presence or absence of two walls is a very small matter in itself, and certainly one to which no great systematic value can

be attached, it would nevertheless, under the present system of classification, be impossible to do otherwise without revising the characteristics of an entire genus and rendering its position in Saccardo's artificial system impossible. These questions are for systematists to decide; in the present investigation it is perfectly immaterial whether its object is called *Fenestella* or *Pseudovalsa.*

As to the species, the one under consideration varies in the structure of its spores from all known species; that is, from all *Fenestella* and *Pseudovalsa* species cited in Saccardo's "Sylloge Fungorum." It can therefore be given the name of *Fenestella platani.*

The ascospores retain the power of germination for a long time. Material that had been kept dry for five months yielded the same results as that which was fresh. This question now suggests itself: Into what do the ascospores develop? The resulting body differs with the substratum. Cultures in nutritive solutions gave different results than those on fresh *Platanus* leaves. We will first follow the development of the fungus in a nutritive solution.

In water, in a nutritive solution like a decoction of the plum, grape juice, or extract of meat, or in some such solution thickened with gelatine, the ascospore germinates, as a rule, within twenty-four hours. Germ tubes arise sometimes from all, sometimes from only one cell in the spore. They penetrate the strong spore membrane, and the protoplasm passes from the spore into the germ-tube, giving the former a paler appearance. Generally the germ-tube swells up immediately after its exit from the spore; this is especially the case in water cultures where the fungus does not develop any further. In this case the germ-tubes generally remain quite short, sometimes becoming almost globose and beginning to cut off spores. Under favorable conditions they grow somewhat longer and even branch, but become divided up into short roundish cells and form gonidia at the apex (Fig. 8). These are oval, unicellular, and colorless. They soon put out a germ-tube, sometimes two, which again detach gonidia in a short time. Their further development was not observed.

In sowings upon gelatine which was mixed with a nutritive solution, the germ-tubes, unlike those sown in water, show a vigorous terminal growth, while their diameter increases very little; but even in this case the base remains thick and composed of short cells. The septa are formed at some distance behind the growing point, and numerous monopodial branches are also developed. On account of the large number of germ-tubes produced by the spore at the same time, and their vigorous growth, the mycelium attains a very considerable growth in a few days, in the center of which the dark-colored spore remains visible for some time.

After from five to six days some of the hyphæ which have come to the surface of the gelatine, or those that run just underneath it, send up numerous branches composed of one or two cells and bearing a pretty

large spherical head, the study of which is not easy. When placed in water it goes to pieces at once, leaving only a mass of colorless, cylindrical cells 3–5μ. long and 1–2μ. in diameter. The structure can be seen only when it can be observed in moist air under a cover glass. At the end of each branch of the mycelium is a globose, gelatinous mass, which swells strongly upon the addition of water and finally breaks in pieces. In it are imbedded a considerable number of the cells already mentioned, lying close together and parallel (Fig. 9). They have been cut off from the sporophore, and the gelatinous mass is composed of the envelopes of the individual gonidia.

The ascospore has therefore produced a gonidia-forming mycelium, a *Hyphomycetes*, belonging to the form *Acrostalagmus*, as is shown by the peculiar structure of the fruiting head. This form seems to be different from that of *A. cinnabarinus*, Corda. When very finely developed it has the appearance of a reddish mat, but the sporophores are never branched as in *A. cinnabarinus*. The spores of the latter are smaller than those of the form under consideration, but the development of the spores and the relations of the gelatinous envelope differ in no way from those of *A. cinnabarinus*. When *Acrostalagmus* was cultivated independently, its development was much more luxuriant; but pycnidia never made their appearance in these cultures; it seemed as if gonidia always reproduced the same gonidial form. It should also be mentioned that when the leaves were infected with ascospores *Acrostalagmus* nearly always appeared.

The development of sporophores and formation of spores continues on the *Fenestella* mycelium for a long time. The great masses of spores which fall off during the study of the fungus often makes this very difficult, and it is principally owing to them that the ascospores themselves are no longer visible.

Afterwards new changes occur in the *Fenestella* mycelium. A dense mat is generally formed by the repeated branching of the hyphæ and the formation of new ones from spores. This mat is called a stroma, although it deviates considerably from that formed in nature. At first the stroma of the slide cultures is not black or brown, but yellowish, which is probably caused by the rapid development incident to abundant moisture, for as a rule old cultures and those kept dryer take on a darker color. It can also be ascribed to the same cause, that the separate hyphæ are more delicate than those observed in nature. The outer form of an artificially produced stroma is therefore different from the natural one, and it can attain considerable dimensions if the substratum is a favorable one. Besides it does not have the conical shape described above, but forms a thin layer about 1 millimeter thick, upon, instead of within, which are the later formed pycnidia. We will return to this point farther on.

About three or four weeks after the sowing of the ascospores, numerous brown bodies, about 1 millimeter in diameter, which proved to be

pycnidia, made their appearance upon the stroma. They are usually arranged more or less in circles. In old stromata one often sees several concentric circles of pycnidia, since new rows are constantly being formed toward the circumference.

The pycnidia appear first as small knots of hyphæ; in certain places in the stroma the hyphæ wind much closer together; these points therefore appear darker, and are easily seen. These knots steadily increase in circumference for some time without any kind of differentiation. They represent merely small outgrowths of the stroma, nor do sections through this immature stage show anything but a homogeneous mass of hyphæ. Next, the young pycnidia begin to turn brown, that is, the outer layer of the tissue becomes dark colored and can be clearly distinguished as the rind. The remaining portion of the pycnidium remains unchanged until finally the hyphæ in the center move apart from each other, forming a small cavity (Fig. 10). This arises from the cessation of growth within the tissue, while the body continues to grow at the periphery. In this way the pycnidium develops into a spherical body containing a large cavity. Below, it is a little immersed in the stroma, but is distinctly separated from it by the outer layer. The wall is composed of two layers, the rind and a clearer layer within, also composed of irregularly interwoven hyphæ, without a trace of pseudo-parenchymatic structure. Immediately after the cavity begins to form, hyphal branches grow out into it and form a continuous hymenium. They cut off very small, cylindrical spores in great numbers. When the pycnidium is mature it ruptures in an irregular manner at the point, and the spores emerge in waxy, yellow, or whitish, worm-shaped masses.

In the preceding description a single pycnidium developing without any hindrance has been considered, but it is often the case that the first stages of any pycnidia arise close together. On account of the enlargement of the knots of hyphæ they collide, assume irregular forms, and grow together into various shaped bodies, yet in such a manner that the bounding lines of the individual pycnidia can be seen by the depressions between them. A rind following the depressions is formed on the outside; but within, the lateral walls are broken through by the formation of the cavities so that the compound body made up of many pycnidia possesses but one cavity. The depressions mentioned above correspond to projections upon the inside. The walls, consequently, appear wrinkled.

Now, are these pycnidia homologous with those with which the investigation started, the *Cytispora?* In the first place it may be stated that the form of the basidia and spores is the same in both, although they are as a rule a littl e smaller in the cultivated pycnidia. The structure of the walls agrees in the two, at least when the *Cytispora* pycnidia are young. The same things many be said of the older, black, and thick-walled pycnidia that have been said above concerning the stroma. The difference is more marked, because in the artificially produced specimens the pycnidia are superficial, while in the natural ones they are sunken

into the stroma. It has, however, been shown that in *Cytispora* individual pycnidia may project beyond the stroma. As regards the artificial ones we have only a variation dependent upon external conditions.

To this correspond the relations of the spontaneous *Cytispora* upon other substrata than twigs. Spores of the same kind were sown upon a well sterilized wilted leaf. The result was a stroma with pycnidia, having exactly the same appearance of that produced upon the slide. Infections of living and dead branches with *Cytispora* spores were without result.

It may also be mentioned that the circular arrangement of the pycnidia upon the slide points to a Valsoid stroma.

The beginnings of the pycnidia and their transformation into irregular chambers can not be so easily studied in the natural as in the cultivated *Cytispora*. But the results are in no way contradictory. In the natural *Cytispora*, also, the beginnings appear as knots of hyphæ of a globose form, which are by the least growth of the stroma brought very close together, and consequently must change their form and even coalesce on further growth.

What has been said suffices to show that there is no difference between the *Cytispora* and the pycnidia produced upon the slide, and that such variations as are present are traceable to the conditions necessary in culture methods; the two are therefore homologous.

Now since the beginnings of *Fenestella* perithecia have been formed directly upon the stroma of *Cytispora*, and the development of *Cytispora*, from the ascospore has been observed step by step upon the slide, the life history of the fungus is closed for us. That perithecia should be produced under the conditions necessary to the culture method was not to be expected. They would likewise have arisen in the form of knots of hyphae within the circle of pycnidia.

Although the pycnidia are extraordinarily small and spermatia-like, they possess the power of germination. In a suitable nutritive solution the spores swell up greatly and develop two or three germ tubes, which are much enlarged at their bases, so that afterwards it is often hard to say which is the swelling and which the spore. They proceed to branch like a budding fungus, afterwards one branch shows a strong growth at one end. Otherwise the mycelium develops in the same manner as from the ascospore.

The life history of the *Fenestella* is, however, by no means completed with what has been recorded. In order to prove whether the fungus was related to the *Cytispora*, sowings of the ascospores were made upon *Platanus* leaves and produced what is presumably a new stage of this pleomorphic form.

The spores were sown in a drop of water and this placed upon the lower surface of fresh young leaves and these kept moist. Germination was observed in a few days, but the penetration of the germ tubes was not seen. The inoculated parts began to turn brown without the fungus

becoming visible. Not until ten or fourteen days after inoculation, when the leaf had become brown and withered, did transparent points, which were most numerous along the nerves and less so upon the leaf surface, make their appearance. These points represent pycnidia, which are altogether different from those of *Cytispora*. They are situated under the epidermis, which they push up while their bases are more or less immersed in the leaf tissue. At the apex of the swellings the epidermis ruptures, forming an irregular roundish opening through which may be seen the ostiolum of the pycnidium, which will be described in detail below. The pycnidium is flattened and lenticular, yellowish in color, except the ostiolum, which is dark brown. Its walls, unlike those of the *Cytispora* (Fig. 11), are of a pronounced pseudoparenchymatic structure. They are clearly composed of two layers, the outer consisting of from one to three rows of flat cells with brown contents. Brown hyphæ usually originate from many of the superficial cells. This layer has a special structure at the apex of the pycnidium. It becomes much thicker and its cells take a radial direction, lying parallel to each other and forming papillæ-form projections on the surface. The papillæ are surrounded by a chaplet of long four or five-celled hyphæ, which arise from the outer cell and project beyond the epidermis. On account of the radial arrangement of the cells at this place the opening of the pycnidium will depend upon its time of maturity, since the cells are easily pushed apart. There is, therefore, here a similar arrangement to that in *Discula platani*.

Within this is a second layer of somewhat polygonal colorless cells which are flattened on the outside, but are more isodiametric within. The farther they are situated toward the interior the smaller their lumina. This layer bounds the cavity of the pycnidium, which is, however, very irregular, since the inner layer sends complex projections into it from all sides. From these, large round cells filled with dense contents arise everywhere. They are the basidia, but they do not form a continuous hymenial layer. They cut off oval (often rather cylindrical) unicellular colorless spores that measure 6–9 by 3–5μ.

These pycnidia are strongly characterized by the structure of their walls, and more especially of their apices, and the form of their basidia. Since little stress is laid upon these characteristics in systematic works, it was impossible to classify it in any existing genus. It would be superfluous to establish a new one, since in all probability it is only a stage in the life history of *Fenestella platani*.

Since the culture of these pycnidia in nutritive solutions was unsuccessful (concerning which more will be said) many questions relative to their development must remain unanswered. The youngest stage observed consisted of a knot of numerous coarse hyphæ (Fig. 12). It appears to originate from the *Cytispora*, although it is noticeably different from the beginnings of the *Cytispora* pycnidia. The number of hyphæ is smaller, but the hyphæ are proportionally stronger. Unfort-

unately it could not be determined whether the cell masses which projected into the cavity and bore a portion of the basidia are remnants of a ruptured tissue or whether they grow out from the inner layer of the wall after the formation of the cavity.

When sown upon gelatine and a nutritive solution the spores will in about twenty hours swell up and produce a germ tube. This develops into a mycelium of short-celled hyphæ whose growth soon ceases, while the cell contents become brown. In this way numerous more or less compact opaque masses of hyphæ are produced, which form a resting condition like sclerotia and may be called resting mycelia.

After remaining in a dry condition for some time these were again placed in a nutritive solution, the hyphæ masses began to grow again, but developed directly into an interwoven tissue and after a short space showed no further phenomena of growth.

But, on the contrary, if one of these resting conditions is placed on a leaf and kept moist the formation of pycnidia will follow. The pycnidia are therefore closely dependent upon the leaf, but this does not make them absolute parasites, since they only become apparent after the leaf is disorganized. Whether this disorganization was caused by the fungus or external causes is hard to say.

As already stated, the above described pycnidia which appear on the leaf are produced by sowing ascospores or by a perennial mycelium. They will develop also, however, if the spores formed in the pycnidia are sown on a leaf. Under the most favorable conditions of growth a pycnidia-forming mycelium arises from these, but under unfavorable circumstances a resting mycelium. Besides this the same pycnidia occurred after the sowing of *Cytispora* spores upon a fresh leaf, the latter being formed in a pycnidium produced under artificial cultivation. The manner of development of the pycnidia on the leaf was the same in all cases.

One important circumstance has not been mentioned. The pycnidia upon the leaves were in most cases accompanied by an *Acrostalagmus* form. But sowings of the latter on fresh leaves only produced the same form again.

We have now mentioned all the forms that could be obtained for observation which it is possible to suppose belong to the life history of *Fenestella platani.* The absolute proof of the connection between the ascospore and pycnidium is lacking in case of the pycnidia on the leaves. What has already been said makes it seem very likely that this stage is really connected with the *Fenestella.* As concerns the other forms, it is true that on the above grounds we can not trace the hyphæ from the gonidiophores of the *Acrostalagmus* back to the ascospores, still less can it be done for the later appearing pycnidia of the *Cytispora.* But the regularity with which both appear in all the cultures, and the similarity of the cultivated *Cytispora* pycnidia with the natural ones, leave no doubt as to their connection.

Aside from pycnidia on the leaves, the development of *Fenestella platani* is as follows:

The ascospores give rise to a mycelium which immediately cuts off gonidia—the *Acrostalagmus* stage. Later the mycelium develops into a stroma in which pycnidia are formed—the *Cytispora* stage. Finally perithecia break out of the stroma between the pycnidia—the *Fenestella* stage. Cultures of *Acrostalagmus* reproduced the same gonidial form, and no pycnidia; cultures of *Cytispora* both artificial and natural yielded the same pycnidia again. Under favorable circumstances, however, perithecia might be developed.

If the pycnidia that occur on the leaves really belong to *Fenestella*, then this fungus possesses both a parasitic and saprophytic cycle of development. The uncertainty which still exists in regard to this makes it undesirable to go farther in order to draw general conclusions.

(*To be continued.*)

PEACH ROT AND PEACH BLIGHT.

(*Monilia fructigena*, Persoon.)

By Erwin F. Smith, Sc. D.

For six years my attention has been drawn repeatedly to the serious losses resulting from the parasitism of *Monilia fructigena* upon plums and other stone fruits, and during the last three years my opportunities for observing its effect upon the peach have been unrivaled. These opportunities occurred principally in the great peach district lying between the Chesapeake and Delaware Bays. There, in the prosecution of the peach-yellows investigation, I have examined hundreds of orchards at all seasons of the year, and have incidentally made some very interesting observations on other diseases of the peach, particularly that resulting from the *Monilia*. It has also been my fortune to see this disease in the peach-belt of southwestern Michigan.

This fungus is more common, and far more destructive than any other observed on the peach in this country. It is rarely absent from the orchard, and in rainy weather it frequently destroys from one-half to three-fourths of the crop, in some cases the entire crop. Under its influence the fruit quickly loses its normal color and flavor, and becomes an entire loss to the grower. As the fungus invades the healthy tissues of the fruit the latter become leather-colored, or dark brown, and the peach is said to "rot," although, as Von Thümen first pointed out, the change is not strictly a rot. For the purposes of this paper it will, however, be convenient to follow the well-established popular usage and speak of this disease as the "peach rot."

So rapid are the changes induced by this fungus that sometimes the

greater part of entire varieties, representing thousands of dollars, may be lost in three or four days. At such times, fruit picked in an apparently sound condition is also very likely to rot on its way to market or in the hands of middlemen or consumers. Of late years peaches grown in Georgia and the far South have been especially troubled by rot during shipment. These peaches ripen in the hot weather of mid-summer and are sent long distances to Northern markets. The loss to Georgia growers is sometimes as much as two-thirds the whole crop. Could this rot be stopped the profit of peach growing the country over would be much increased—probably doubled. This general statement is based on observation and on inquiries among peach growers in a half dozen States. The peach is well known to be a delicate and perishable fruit, but it is not so generally known through just what agencies this decay occurs. An examination, however, of the fruit stalls in any city market, especially during hot and moist weather, will satisfy the most skeptical that this omnipresent fungus is the chief cause of the rapid decay, in fact, almost the sole cause.

Peaches uninjured by *Monilia* and missed in gathering sometimes hang on the trees several weeks, the skin remaining bright but the flesh becoming very soft and of a subvinous flavor. Fruit growers, as a rule, are entirely ignorant of the presence of any fungus. They do not know the cause of the rot but are painfully conscious of the result, since the latter can be expressed in pecuniary terms. The rot is frequently known as "scald" and is usually ascribed to hot and wet weather, but in this instance, as in many others, the weather is only a favoring condition, the real cause, the *sine qua non*, being the fungus, whose ash-gray spore-tufts are so often seen on the shrunken and discolored surface of the peach.

If the consensus of opinion among peach growers is of any value this rot is most uniformly destructive to early peaches, a very considerable portion of which rot every year. Whether this tendency in early varieties is due to a thinner skin, or to hotter weather during the time of their maturing, I am unable to say positively. It has been ascribed to the former and may in part be due to this, but I am not aware of any extensive series of observations made to determine the relative thickness or resisting power of peach skins. That this or some other unknown varietal peculiarity somewhat affects the spread of the disease is not improbable. I did think that certain of the early sorts, *e. g.*, Hale's Early, were specially subject to rot, but have given up this view as untenable. All the very early varieties rot badly, though in the same orchard not always to the same extent.

The well-known influence of moisture and especially of high temperature upon the rapid development of the fungus, facts which I have observed repeatedly in the orchard and have verified in the laboratory, lead me to think that the frequent rains and usual hot weather of July and the first part of August must be the principal reason why early

varieties always rot more or less, and generally much worse than middle or late sorts. It would, however, be a mistake to suppose that any variety is wholly exempt. Even sorts with the firmest flesh, *e. g.*, Troth's Early and Smock, perish very quickly if the meteorological conditions are favorable to the growth of the fungus. A single rain near the period of ripening will often immediately double or treble the number of rotting fruits.

It is also a great mistake to suppose the skin of the peach must first be punctured by insects or injured in some other way before the fungus can find an entrance. Every peach grower of long experience knows that this is not true, and any one can satisfy himself on this point by giving to the subject a little patient consideration. Injured fruits are more easily infected; that is all. In years of abundance only a small proportion of the peaches which remain on the trees are punctured by the curculio or otherwise injured, yet the entire crop may rot very quickly during a rainy period, or during a series of hot days, with occasional rains or heavy dews. Moreover, in the laboratory I have infected the soundest peaches by merely sowing a few *Monilia* spores in a drop of water upon their surface, the control spots remaining entirely sound. To be most successful this experiment must be conducted in an atmosphere nearly saturated with vapor of water and at a temperature not much below 90° F. In the laboratory, as well as in the field, an increase in temperature of 10° to 20° above the normal causes an astonishing increase in the rapidity of the rot.

Some reference to the actual losses resulting from this rot during the autumn of 1888 will serve to show what happens not infrequently, and will afford ample basis for judgment as to the economic importance of restrictive measures.

The peach crop of the Delaware and Chesapeake Peninsula is well known to have been unusually abundant in 1888. I traveled extensively in six counties and saw for myself. All varieties fruited and the orchards bent under the weight of their precious burden. Even old, broken, neglected trees, in fence rows and pastures, were full of fruit. The early and middle varieties were gathered uninjured, except by a single windstorm, and were sold at prices ranging from 50 cents to $1.25 and upwards a basket. Until the end of the first week in September there was also every prospect for a very large crop of Smock and similar productive late peaches, which are planted very extensively for drying purposes. September 7 rainy weather set in over the upper part of the Peninsula, and continued almost uninterruptedly for five or six days. When it was not actually raining it was lowering and the air was full of moisture. These remarks apply especially to the counties of Kent and Cecil in Maryland and to Kent and New Castle in Delaware. At this date the Smock peaches were almost or quite ready to pick. The weather was not excessively warm, but the rain was so nearly continuous, and the spores of the *Monilia* were so widespread, that a veritable

epiphytotic ensued.* Every day thousands of baskets of green and ripening peaches rotted upon the trees and on the way to market.

In consequence of this rot the late peaches were nowhere very profitable, and in many instances were an entire loss. The daily railroad shipments, instead of increasing with the coming on of the Smock, fell off within a few days from scores of car loads to a few dozen, and must have fallen away almost to nothing had only sound peaches been shipped. The condition of much of the fruit forwarded during this week is sufficiently characterized by the following clipping from a Philadelphia daily of September 15:

The local peach market is utterly demoralized, not on account of the quantity of fruit but on account of the quality. No such mess called peaches was ever marketed before as has been arriving during the past few days. The season is practically ended and but few more good Delaware peaches will be received.

The total shipment of peaches over the Delaware Railway from September 9 to September 17 was but 711 car-loads; on September 14, 15, and 17, it was respectively only 46, 35, and 30 car-loads. None were shipped on Sunday, the 16th, and none of any consequence after the 17th. The shipments for four weeks previous to this time, August 13 to September 8, averaged about 195 car-loads per day. These spoiled peaches went begging at prices ranging from 7 to 25 cents per basket, the most of them being sold for 10 or 15 cents. At that time good fruit readily commanded 59 to 65 cents per basket of five-eighths bushel.

From intelligent and trustworthy peach growers on the Peninsula I have received many oral and written statements like the following, the amount of individual loss varying from a few baskets to many thousand, according to the acreage and the varieties planted:

In my orchard in Kent County, Md., probably 500 baskets (6,000 trees). In the county at large many thousands of baskets were probably lost.—[Dr. John J. Black, New Castle, Del.]

My own loss was perhaps 3,000 baskets.—[Dr. Henry Ridgely, Dover, Del.]

I lost 4,000 baskets.—[Norris Barnard, Still Pond, Md.]

My individual loss was not less than 2,000 baskets from an orchard of 6,000 trees.—[W. H. Burnite, Felton, Del.]

I am satisfied that my loss was from 5,000 to 6,000 baskets.—[James S. Harris, Still Pond, Md.]

My loss was about 7,000 baskets.—[Thomas D. France, Chestertown, Md.]

I lost from 10,000 to 15,000 baskets, 3,000 baskets rotting on their way to market.—[F. H. Harper, Still Pond, Md.]

In the week you speak of I lost 20,000 baskets. * * * We lost all our fruit that ripened after the Crawford's Late. The varieties lost will number at least one-half of all our orchards. In mine they represented two-thirds.—[Wilbur Eliason, Chestertown, Md.]

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*Aside from the repeated precipitation the principal peculiarity of the weather was the slight range of temperature. The variation at Dover during seventy-eight hours (a. m. of September 8 to p. m. of September 11) was only 14° F., while for the first thirty-six hours it kept between 70° and 82°, and did not at any time fall below 68°. After this the range was greater, but during the next five days the day temperature was above 70° four times and touched 83° on the 16th.

Mr. France estimates the loss in his county (Kent, Md.) at 400,000 baskets. Mr. Eliason (same county) also places the loss at 400,000 baskets. Mr. Harris (same county) thinks the loss was from one-fifth to one-sixth of the entire crop.

Norris Barnard estimates the loss on the Peninsula at one fourth of the whole crop. W. H. Burnite places the loss on the Peninsula at "one-sixth of the entire crop." Dr. Ridgely states that, at the time, the estimated money loss was $300,000.

Assuming the loss to have been only one-sixth of the total crop, and the value only 50 cents per basket, we have an approximate total loss of 800,000 baskets, worth $400,000. On first thought this seems like a rash or inflated statement. A personal acquaintance, however, with the orchards of this entire region, and a knowledge of the great extent to which Smock and other late peaches are planted, leads me to believe it is entirely warranted. In fact, it is probably under the actual loss, for in the upper part of the district in question these varieties are found in almost every orchard, while in many they include thousands of trees.*

This estimate is also established by the fact that in spite of the rot, and not counting the enormous number of peaches canned, dried, consumed, and sent away by water, the shipments from the Chesapeake and Delaware peninsula, by railroad alone, were upwards of 3,000,000 baskets (five eighths of a bushel), worth probably over $2,000,000—a crop only distanced by that of the famous year 1875, when the railroad shipments exceeded 4,500,000 baskets. But for the rot, the peach shipment of 1888 would undoubtedly have been nearly or quite equal to that of 1875, since in a productive year like 1888 the varieties which ripen after Crawford's Late are generally equal to about one-third of the whole crop.

This enormous loss of more than 800,000 baskets is to be attributed almost wholly to the destructive activity of the rot fungus. Could this fungus have been destroyed completely on the 1st day of September, or earlier in the season, the rot would not have appeared. Could it have been partially exterminated, the rot would have been proportionately less.

In this fungus the common mode of propagation from peach to peach, and the only known one, is by means of ash-gray conidia, which are produced in great numbers on the brown surface of the affected parts. These spores generally occur in little hemispherical tufts or confluent masses on bundles of hyphal threads which have burst through the skin of the peach. The mycelium ramifies abundantly in the decaying tis-

*Since this was written I have talked with Superintendent I. N. Mills, who informs me that the estimate of the railroad company's agent, after traveling over the territory in question, was 1,000,000 baskets, while the sum total of estimates sent in by the local freight agents was one-half greater. Mr. Mills himself places the loss at about 1,200,000 baskets.

sues and the number of conidial tufts visible on the surface seems to depend to a considerable extent on the amount of moisture in the air and on the length of time the peach has been affected. From these little, dusty, ash-colored tufts, which every peach grower must have observed, the infection is very readily transmitted to healthy peaches. Rains, winds, birds, insects, etc., all help to disseminate the spores and those which find suitable lodgment are very likely to germinate and extend the disease if the atmospheric conditions are at all favorable. Of course myriads of spores miscarry and other myriads perish before germination or during its progress, otherwise the peach and kindred fruits must long since have perished from the earth. Ample provision, however, has been made for the perpetuation of this parasite by endowing it with a fecundity which more than compensates for the small size and perishable nature of its spores. After some weeks, however, the conidia cease to be produced and the ash-gray tufts gradually disappear.

The disappearance of the conidial tufts is not, however, the end of the fungus. This winters over as a resting mycelium in the destroyed peaches which have either fallen to the earth or still hang upon the branches in a dry, wrinkled, mummified state. Early in the spring, if the atmospheric conditions are favorable, the fungus awakes to renewed activity—another crop of conidia is produced from new tufts borne on the old mycelium and the work of destruction begins anew. In the spring of 1889 I witnessed this for the first time, and was able to settle beyond doubt that the fungus winters over in the decayed fruits, especially in those which remain hanging upon the trees. This fact is one of great practical importance. The ordinary spores (conidia) being of a perishable nature it has occurred to many mycologists that *Monilia* must exist during a portion of the year under some other form—one capable of passing in safety through the inclement season. With this thought in mind I had been watching the fungus very narrowly for several seasons, but all to no purpose until May of this year. Then, thanks to a very rainy week, I came suddenly upon the explanation I was seeking.

Earlier in the year, when the peaches were in blossom and beginning to put forth their foliage, I was in the Delaware orchards, and was greatly perplexed to find the *Monilia* appearing suddenly everywhere on the blossoms and young fruit. This was first observed about April 29, in moist weather, soon after an unprecedentedly heavy and prolonged rain-fall.*

The orchards blossomed abundantly, but the greater part of the peach

*At Dover it poured continually for twenty hours (8 p. m. of 25th to 4 p. m. of 26th), and reports from the upper portion of the peninsula also indicated a very heavy rainfall. It also rained in showers on the 27th, all day. The precipitation at Dover from the first storm must have been at least six inches. A few peach-orchards were then in full blossom, but the majority were a day or two in advance and nearly or quite out of blossom.

crop in four counties was destroyed at this time. There had been no frosts of any consequence and the loss was generally ascribed to the rain. This was said to have washed off the pollen, but most of the orchards were just out of blossom when the rains began, and the real agent of destruction was the rot-fungus, favored, of course, by the excessive precipitation. The loss from this source in April and May, 1889, in all probability exceeded 500,000 baskets. The rot was also very bad in June and July. Hundreds of orchards in the upper portion of the peninsula produced no peaches whatever, and the railroad shipment from the whole district was only about one-half that of 1888.

Previously I was not aware that *Monilia* made its appearance so early. I had looked upon it rather as a summer or autumn fungus, but here it was in April.

Whence came the rot so suddenly? I could not tell; but in Maryland a few weeks later, during another rainy week, I saw all at once clearly what I failed to see in Delaware. This was May 16, when the young peaches were about the size of filberts or a little larger. From time to time all the winter and spring I had been inspecting the fungus-destroyed fruits of the previous season, hoping to find something. On this date I was working at another subject in a large orchard where fruit rotted the previous year. The prolonged rains had thoroughly softened the mummified peaches still clinging to the branches. Casually examining one of these, for perhaps the twentieth time, I was astonished to find its surface covered with the familiar conidial tufts. Previous to the rains I had been in that orchard, and there and elsewhere I had examined hundreds of the mummified fruits without finding a vestige of the spore-tufts of the previous summer. Indeed, the rains and winds generally destroy all traces before winter sets in, yet here they were as abundant and fresh in appearance as if grown from a newly-rotted peach. This discovery led to a careful search. On that day, and the wet ones immediately following, I found dozens of mummified fruits covered with the ash-gray tufts. In fact, about one-third of all I examined bore conidial tufts, and in no case were these the growth of the previous season. They had recently pushed from the interior of the rain-softened peaches, and they were particularly abundant after a prolonged, soaking rain. In a series of careful experiments under suitable control, I experienced no difficulty in infecting and rotting green peaches, plums, and cherries with conidia taken from these tufts. At that time, and especially some days later, great numbers of the young peaches perished from a natural infection during a continuance of the rainy weather, the mummified peaches being plentiful and their spore-dust abundant and easily disseminated.

My observations on this point confirm those made by Dr. J. C. Arthur on the cherry in 1885* and by Dr Paul Sorauer on the apple in 1889.†

* Fourth An. Rep. N. Y. Agric. Exp. Sta. for 1885, p. 255.
†*Hamburger Garten- und Blumenzeitung*, 1889, Heft. I, p. 10–13.

They leave no doubt as to where and how this parasite passes the winter season.

This wide-spread and destructive fungus has naturally received considerable attention from mycologists, although the published accounts, especially the European, are somewhat meager. It is apparently more common and destructive in this country than in Europe, for it is not even mentioned in Winter's *Die durch Pilze verursachten Krankheiten der Kultur Gewächse*, or Von Thümen's *Die Bekämpfung der Pilzkrankheiten.* The summer form has been seen and described repeatedly, but no one has been able to connect these perishable organs with any other fungus, or to find resting spores. The cycle of development has remained hidden, and all attempts at prevention have therefore been simply gropings in the dark. Woronin has recently suggested that this fungus may be the conidial state of some *Peziza.* The fungus, for aught we know, may have an ascosporous form belonging to this or some kindred group, but such a form has never been seen and is unnecessary to the completion of its annual cycle. Moreover, if the fungus once produced asci, it may have lost this power during the lapse of ages. However this may be, it is certain that the mycelium which winters over in the dried tissues is amply sufficient to reproduce the plant each spring. This would still be true if it retained its vitality in only now and then a rotted fruit, for under favorable circumstances the mycelium in a single peach may produce a thousand or even two thousand conidial tufts, and each one is certainly capable of producing from five hundred to a thousand spores.

That the fungus may sometimes winter over in the twigs of the peach is also possible, for not only is the fruit destroyed in the manner just described, but sometimes growing shoots are also attacked and killed.

When the rot appears in the twigs it is commonly called "blight." I first discovered this blight in the summer of 1887, in Delaware, where it was unusually prevalent. Trees thus attacked present a very peculiar appearance, quite suggestive of blight in the apple and pear, only in the peach the destruction appears to be confined principally to twigs, the injury seldom extending to branches which have formed more than two annual rings. The reason for this is apparent, or at least not far to seek. Peaches are borne on very short pedicels on branches of last season's growth, and beyond their point of attachment there is usually from 3 to 18 inches of leafy elongating shoot axis, which will mature buds for the fruit and branches of the following season. In summer and autumn the blight of peach stems is always, or almost always, traceable to infection derived from mycelium. The spores do not figure here. This mycelium originates in the rotting peach; bores through the pedicel into the stem; ramifies in the latter, especially near the place of its entrance; and quickly destroys all the distal portion of the branch. Frequently the twig dies back a few inches further than the point of attachment of the peach, and sometimes a much greater dis-

tance, especially if all the foliage-bearing shoots are killed. The *direct* injury appears, however, to be confined principally to that part of the stem in the immediate vicinity of the peach. There the tissues of the stem are browned and killed by the parasite. The distal portion of the stem, the leafy shoot axis, often shows no trace of the fungus, but dries up as if girdled. Of hundreds of blighted stems examined in 1887, I saw none which were not associated with rotted peaches. Last summer and this summer I observed the same fact, although the blight was less prevalent. The earliest varieties blight most, and trees not in fruit never blight at this time of year. In the early spring, however, the young and tender shoots must be infected by spores. Many such shoots were attacked and killed in 1889.*

As a rule the fungus produces its conidial tufts much less frequently on stems than on fruit. Occasionally I have seen them on branches of the previous season's growth, but generally they are more abundant on tissues only recently out of the meristematic condition, *e. g.* on young stems in early spring.

This twig blight is well known to peach growers in Maryland and Delaware, and has been for years, although I have never seen any printed statement of the fact. In wet seasons it sometimes does more injury than the rot, because when many branches are destroyed the tree is not only injured, but the next year's crop is proportionately reduced. In some instances I have seen as many as one hundred blighted twigs on a single tree, the crown of green foliage being curiously interspersed with dead stems and withered leaves. Certain observant peach growers, to whom I mentioned the dependence of blight upon rot, assured me that they knew it already and could and did prevent it by promptly removing the rotting fruits. One man of large experience has known trees to be much injured by neglect of this precaution.

This paper, in which I have purposely avoided all questions of histology, would not be complete without some reference to means of prevention. The difficulties in the way of preventive treatment are great on account of the omnivorous nature of the fungus, yet I believe that they may be overcome and that a large measure of protection is quite within the range of possibilities.

I have quickly induced the rot in apples, pears, and peaches with spores taken from the plum; in cherries and plums with spores taken from the peach; in peaches and plums with spores taken from the cherry. The fungus infecting all these fruits is apparently one and the same. It occurs destructively on peaches, apricots, plums, and cherries, to some extent also on apples, pears, and quinces. It has also been reported as growing on grapes, gourds, the medlar, and *Cornus mas.* Dr. Arthur induced it to grow on blackberries, and Sorauer on green hazelnuts. I also found it to grow in green rose hips, but not vigorously,

* This blight must not be confused with that caused by a small larva which bores in the ends of the stems in early spring, and sometimes does considerable injury.

even under seemingly favorable conditions. The shrubby and arborescent *Pomeæ* and *Pruneæ*, especially the stone fruits, are the principal sources of infection. If we could control the disease in our orchards, the danger from outside sources would be slight.

The question of treatment naturally divides into two portions (*a*) orchard hygiene and (*b*) use of fungicides.

From what has been said it is apparent that two factors are necessary to the production of the rot:

(1) The presence of the rot fungus;

(2) The existence of meteorological conditions favorable to its rapid development.

The control of meteorological phenomena being impossible, the question arises: Can the rot be held in check by the destruction of the fungus? Fortunately we are able to give an affirmative answer. In this connection the importance of knowing where the fungus passes the winter becomes strikingly apparent. If its preservation through the winter and its reproduction in the spring depend wholly or in great part upon the existence of a dormant mycelium, then the systematic gathering and burying or burning of all rotten fruits in summer and autumn will very materially lessen the prevalence of the rot. Especially will this be true if the work of destruction is continued year after year as all work of this kind must be. The remedy here proposed rests on sound principles and is both practicable and practical. If applied on a large scale, systematically, throughout a peach district, and for a series of years, it could not fail to bring decided results. To be very successful it must be done thoroughly and by united effort. Too much stress can not be laid upon the removal and destruction of all the rotted fruits. *None must be left upon the ground or upon the trees.* Moreover, all the fruit-growers of a locality must unite if they would get the best results from this method, which is precisely that recommended for the extermination of noxious weeds, *i. e.*, allow none to go to seed.

Every husbandman knows that, in spite of thrift and painstaking, the farms of a whole community are threatened if only one man allows his fields to become the nursery of bad weeds. From the fields of this careless or negligent person the seeds of pestiferous plants are carried by animals, washed by rains, blown by winds, or transported by the hand of man outward in all directions, to curse the industrious. In the same way in dealing with this fungus one neglected orchard may furnish spores enough to reinfect all the surrounding orchards. In union only is there anything like safety. On the start it will be hopeless to expect united effort but this will come in time. Men who will not practice well-established rules of orchard hygiene ought to abandon fruit-growing. They are behind the times and in the wrong calling. Successful fruit-growing requires men of brains and decision. Prices are low, competition is severe, and, if any money is to be made, this business must be conducted intelligently in the light of all the knowledge

we can get. Even with united and unremitting zeal no more can be expected from orchard hygiene than would be anticipated from like efforts directed toward the extermination of a weed. With these provisos, it may be said that this method is full of hope. It is worth trying even if neighbors will not lend a helping hand, especially if other orchards are somewhat remote. Whether it will *pay* to struggle alone must depend on various contingencies, especially the price of fruit and the cost of labor. I am inclined to think it will, but this can be determined only by actual trial.

The proposed remedy is easy to put into operation. Every year when peaches are being picked a little additional labor would suffice to remove all the rotted and rotting peaches. The earlier this is begun the more secure will be the varieties next in order of ripening. Moreover, if at any time during the season a hot or rainy spell supervenes, and the fruit shows a tendency to rot before it is ripe, men should be put into the orchard *immediately* with instructions to remove every trace of rotting fruit. The same trees must be gone over again the next day, or the day after at furthest, so as to secure and remove all freshly rotted fruits, 24 to 36 hours being ample time to develop incipient cases not noticeable on the first gathering. The work must be done *very quickly and very thoroughly* in order that the rotting fruits may be removed and buried before the spores appear upon their surface to scatter destruction everywhere and undo all that has been done previously. Finally, in the late autumn, after the leaves have fallen, the entire orchard should be re-examined and all dried peaches lying on the earth or still clinging to the branches should be scrupulously removed and buried or burned.

I have so much confidence in the ultimate success of this method that I can not too earnestly urge its practice upon peach growers. If it were followed systematically for a series of years I believe the loss from peach rot would be reduced to inconsiderable proportions. This granted it is unnecessary to enlarge upon the resulting benefit to growers.

In regard to fungicides there is yet little to be said. Some experiments designed to preserve the fruit while on its way to market have been made by various growers. These indicate a possibility of delaying the decay some days by dipping into harmless sulphur compounds, *e. g.*, solutions of liver of sulphur, or of sulphur and cooking soda, and drying before packing into baskets for shipment. As an experiment, dry sulphur might also be dusted on the gathered fruit. All these methods are open to objection on the double score of cost and uncertainty. It is possible also that the spraying of some fungicide upon the trees and fruit will be found efficacious, but up to this time no fungicidal treatment appears to have been worked out to any satisfactory conclusion. Von Thümen recommends the repeated dry dusting of trees and fruit with sulphur, beginning in July. This might possibly answer the purpose, but the expense involved would be very considerable. So far

as I know it has never been tried in this country on any extended scale, but some experiments made this season by J. D. Husted, of Vineyard, Ga., gave favorable results. He dusted on sulphur twice, three weeks apart, using a bellows, and making the first application when the peaches were half grown. Probably as many as four applications should be made.

On the whole, the best hope of success appears to be offered by the method first outlined, *i. e.*, the prompt and persistent removal of sources of infection by the destruction of all rotting fruit; but the two methods might be combined.

ANOTHER SPHÆROTHECA UPON PHYTOPTUS DISTORTIONS.

By Byron D. Halsted.

As an addition to the note in the Journal of Mycology (Vol. 5, No. 1) upon the *Sphærotheca phytoptophila*, K. & S., found in the buds of the distorted branches of the hackberry (*Celtis occidentalis*), it may be said that the mature perithecia of the *Sphærotheca pruinosa*, C. & P., were found in abundance in the malformed inflorescences of the common sumach (*Rhus glabra*), caused by some species of a phytoptus mite. As far as can be learned the ascigerous fruit of this *Sphærotheca* is rare, although the leaves may frequently be attacked by the mildew and abound in the conidia. What is most interesting is that the fully developed perithecia were found among the abortive flowers as early as the middle of July and at a time when no fruit of this sort need be expected upon the leaves. This is another case of the abnormally developed part of a host being the most favorable for the growth of a parasitic fungus. It is perhaps to be expected that the tissue of a plant rendered more soft and irregular upon the exposed surface would supply the conditions for a vigorous growth of a mildew that is practically superficial. The spores would more easily be held in the niches of the distorted inflorescence and find the proper conditions for a rapid growth. It is also interesting to observe that this is also another *Sphærotheca*, which genus may have a particular fondness for the distortions of mites Have other phytoptous growths been found infested with members of the *Erysipheæ*?

NORTH AMERICAN AGARICS.

Genus *Russula* (*russulus*, reddish), Fr. Hym. Eur., p. 459.

By ROBERT K. MACADAM.

PART II.

III. RIGIDÆ.

12. "R. LACTEA, (Pers.) Fr. Hym. Eur., p. 443; Stev., B. F., p. 118; Sacc. Syll., Vol. v., p. 459. Pileus 2 inches (5 centimeters) broad, at first *milk-white, then tan-white, throughout compactly fleshy*, campanulate then convex, often eccentric without a pellicle, always dry (at first even, then slightly cracked when dry), margin straight, thin, obtuse, even; flesh compact, white. Stem 1½–2 inches (4–5 centimeters) long, 1½ inches (4 centimeters) thick, solid, very compact, but at length spongy-soft within, equal, even, always white. Gills *free*, very broad, *thick*, distant, rigid, forked, white.

"Mild, the gills are at length adnate, forked at the base and apex. Care must be taken not to confound it with other *Russulæ* which have changed color and become white. In mixed woods. Uncommon. August.

"Name *lac*, milk. Milk-white. (Fr. Monogr., ii. p. 190; B. & Br., 1133; C. Hbk., n. 621; S. Mycol. Scot., n. 591; Ag., Pers. Krombh., t. 61, f. 1–2; Barla, t. 15, f. 1–13; Paul., t. 74, f. 2.)"—Stevenson.

Edible and of good flavor. North Carolina and Pennsylvania, Schweinitz; North Carolina, Curtis; California, Harkness & Moore; Wisconsin, Bundy; Ohio, in beech woods, Morgan.

13. "R. VIRESCENS, (Schæff.) Fr. Hym. Eur., p. 443; Stev., B. F., p. 119; Sacc. Syll., Vol. v., p. 460. Pileus 2–4 inches (5–10 centimeters) broad, green, compactly fleshy, globose then expanded, at length depressed, often unequal, always dry, not furnished with a pellicle, wherefore the *flocculose cuticle is broken up into patches or warts*, margin straight, obtuse, *even*; flesh white, not very compact. Stem 1–2 inches (2.5–5 centimeters) long, ½ inch (12 millimeters) thick, solid, internally spongy, firm, *somewhat rivulose*, white. Gills free, somewhat crowded, sometimes equal, sometimes forked, with a few shorter ones intermixed, *white*.

"Edible. Taste mild. It varies in size and color of pileus, which is sometimes deep, sometimes pallid green, sometimes yellowish, then green. The gills are not so broad in front as those of neighboring species. It is very easily distinguished from all others except *R. crustosa*, by the green pileus being without a pellicle and innato-flocculose, then rivulose, and scaly in the form of patches. In woods. Frequent. July to September.—Stevenson.

"Stem variable in form, slightly reticulated with raised lines. Spores scarcely echinulate, almost globular, 6μ."—W. G. S. "Name—*Vireo*, to be green. (Fr. Mongr., ii, p. 190; Berk. Out., p. 212, t. 13, f. 6; C. Hbk., n. 632; S. Mycol. Scot., n. 592; Hussey, ii, t. 11; Ag. Schæff., t. 94, excluding f. 1; Vittad., t. 31; Sturm Deutschl, Fl., iii, 3, t. 31; Barla, t. 16, f. 10–12; Ventur., t. 17, f. 1, 2; Krombh., t. 67, f. 1–10.)"—Stevenson.

"Of various livid hues—yellow, purple, and green."—M. J. B.

"Specimens sometimes occur in which the margin is wholly or partly *striate*. The warts are sometimes pale brown."—Peck.

Of this Fries says "*antiquitus edulis.*" It is about the best edible mushroom we have, tender and of a fine nutty flavor. Its greenish cap, breaking up into *areas*, distinguishing it from all others except No. 28, *R. crustosa* (also mild), which has the same habit and is sometimes greenish. *R. furcata*, also with a greenish cap, but remaining *smooth*, is easily separated by its bitter taste.

North Carolina and Pennsylvania, common, Schweinitz; North Carolina, Curtis; Massachusetts, Sprague, Farlow, Frost, Palmer; Minnesota, in woods, July, September, Johnson; New York, grassy grounds, June and July, Peck, twenty-fourth and thirty-third reports; Wisconsin, Bundy; Ohio and Kentucky, Morgan; Maryland, sometimes as large as a breakfast plate; Mississippi, Banning; New Jersey, Ellis.

14. "R. LEPIDA, Fr., Hym. Eur., p. 444; Stev., B. F., p. 119; Sacc. Syll., Vol. V, p. 461. Pileus 3 inches (7.5 centimeters) broad, *blood-red rose*, becoming pale, whitish especially at the disk, somewhat equally fleshy, convex then expanded, scarcely depressed, obtuse, opaque, unpolished, *with a silky appearance at length, often rimoso-squamulose*, margin spreading obtuse, without striæ. Stem as much as 3 inches (7.5 centimeters) long, 1 inch (2.5 centimeters) thick, *even, white or rose color.* Gills rounded behind, rather thick, somewhat crowded, often forked, connected by veins, white, often red at the edge. Edible. Taste mild; wholly compact and firm, but the flesh is cheesy, not somewhat grumous. The gills are often red at the edge, chiefly towards the margin, on account of the margin of the pileus being continuous with the gills. In mixed woods. Frequent. September to October.

"Name—*lepidus*, neat, elegant. (Fr. Monogr., ii, p. 191; Sv. ätl. Sv., t. 59; Berk. Out., p. 212; C. Hbk., n. 623; S. Mycol. Scot., n. 593; Hussey, ii, t. 32; Hogg & Johnst., t. 4; Ag. Krombh., t. 64, f. 19, 20; Batsch, t. 13, very small.)"—Stevenson.

Spores 8–10 by 6–8μ. Sacc. Syll. One of the best edible species. *R. emetica* and *R. rubra* (both poisonous) resemble this, but differ in having the pileus polished. North Carolina, in pine woods, Curtis; Massachusetts, Frost, Palmer; Minnesota, July, August, Johnson; Califonia, Harkness & Moore; Ohio, in beech woods, Morgan; New York, generally with the pileus red, but quite variable in this respect, woods, August. Peck, forty-first Rep.

15. "R. RUBRA, Fr., Hym. Eur., 444, Stev., B. F., p. 120; Cke., iii, 1025; Sacc. Syll., Vol. V, p. 462. Pileus unicoloros, cinnabar-vermilion but becoming pale (tan) when old, disk commonly darker, compact, hard but fragile, convex then flattened, here and there depressed, absolutely dry, *without a pellicle but becoming polished-even*, often rivuloso-rimose when old, margin spreading obtuse, even, always persistent; flesh white, *reddish under the cuticle.* Stem 2–3 inches (5–7.5 centimeters) long; about 1 inch (2.5 centimeters) thick; solid, even, varying white and red. Gills obtusely adnate, somewhat crowded, whitish then yellowish, with dimidiate and forked ones intermixed. Very *acrid*, very hard and rigid, most distinct from all the others of this group in the *pileus becoming polished-even*, although without a pellicle, in the *flesh being somewhat grumous* and in the *very acrid taste.* Gills often red at the edge. In mixed woods. Frequent. August to November. Poisonous. Spores whitish. Fr.; sphæroid, 8–10μ. K. Name—*ruber*, red. (Fr., Monogr., ii, p. 191; Sv. ätl. Sv., t. 49; Berk. Out., p. 212; C. Hbk., n. 624; S. Mycol. Scot., n. 594; Ag. Decand—Barla, t. 15, f. 1–10; Krombh., t. 65; Vitt. Mang., t. 38, f. 2, not Bull; Schaeff., t. 15, f. 4–6."—Stevenson. North Carolina, Pennsylvania, Schweinitz; North Carolina, Curtis; New York, July, Peck; Massachusetts, Frost; Minnesota in woods, July and August, Johnson; Wisconsin, Bundy; California, Harkness & Moore; Maryland, Miss Banning.

16. "R. FLAVIDA, Peck, 32d Rep. N. Y. State Mus. Nat. Hist., 1879, p. 32. Pileus fleshy convex, slightly depressed, unpolished, bright yellow; lamellæ white, adnate, turning cinereous; stem yellow, solid, white at the extreme apex."—Frost, M. S.

"Pileus 1–2 inches (2.5–5 centimeters) broad, fleshy, convex, then plane or slightly depressed, yellow, becoming paler with age; flesh white, the margin at first even, then tuberculate-striate; gills nearly simple, subdistant and broader before, adnate, white, the interspaces venose; stem 1–2 inches (2.5–5 centimeters) long, $\frac{1}{3}$–$\frac{1}{2}$ inch (8–12 millimeters) thick, short, equal or tapering upward, firm, glabrous, solid or merely spongy within, yellow; spores globose, 6–7.5μ in diameter.

"Taste mild. Gregarious. Grassy places in copses and open woods. Sandlake. July and August. The pileus is dry, and sometimes slightly mealy or granular. When young it is bright yellow; but it fades with age, and sometimes becomes white on the margin."—Peck.

This is one of the species found by Mr. Frost, but never published by him. Massachusetts, Frost; New York, Peck. Thirty-second Report and Bulletin, 1887.

17. "R. CINNAMOMEA, Miss M. E. Banning, Bot. Gaz., Jan., 1881. Pileus 4–6 inches (10–15 centimeters) broad, dry, fleshy, centrally depressed, cinnamon color, rimoso-squamose, the cuticle generally breaking up into flocci or granules; flesh dry, spongy, tinged with ocher. Gills concoloros, narrow, forked, close, sinuate near the margin. Stem 2–3 inches (5–7.5 centimeters) or more long, 1 inch (2.5 centimeters)

thick, regular, smooth, pallid, blunt, at first stuffed, then hollow; spores globose, 8μ in diameter. Taste acrid. In woods near Baltimore. June and July."—Ban.

IV. HETEROPHYLLÆ.

18. "R. VESCA, Fr., Hym. Eur., p. 446; Stev., B. F., p. 122; Sacc. Syll., Vol. V, p. 465. Pileus *red-flesh color, disc darker*, fleshy, slightly firm, plano-depressed, *slightly wrinkled with veins*, with a viscid pellicle, margin at length spreading; flesh cheesy, firm, shining white. Stem *solid*, compact, externally rigid, *reticulated and wrinkled* in a peculiar manner, often attenuated at the base, shining white. Gills adnate, crowded, thin, shining white, with many unequal and forked ones intermixed, but scarcely connected by veins. Of middle stature. Taste mild, pleasant. In mixed woods. Frequent. September to October. Name, *vesco*, to feed. From its edible qualities. (Fr., Monogr., ii, p. 193; Sv. ält. Sv., t. 63; Berk. Out., p. 211; C. Hbk., n. 625; S. Mycol. Scot., n. 596; Hussey, i, t. 89.)"—Stevenson.

An edible species of fine flavor. Its peculiarly reticulated stem will assist in separating it from the noxious *R. rubra* which resembles it in the color of the pileus. California, Harkness & Moore.

19. "R. CYANOXANTHA, (Schæff.) Fr., Hym. Eur., p. 446; Stev., B. F., p. 122; Sacc. Syll., Vol. V, p. 465. Pileus 2–3 inches (5–7.5 centimeters) and more broad, *lilac or purplish, then olivaceous-green*, disc commonly becoming pale, often yellowish; *margin* commonly *azure-blue or livid purple, compact*, convex, then plane, then depressed or infundibuliform, sometimes even, sometimes wrinkled or streaked, viscous, margin deflexed, then expanded, remotely and slightly striate; flesh firm, cheesy, white, commonly reddish beneath the separable pellicle. Stem 2–3 inches (5–7.5 centimeters) long, as much as 1 inch (2.5 centimeters) thick, *spongy-stuffed*, but firm, often cavernous within when old; equal, smooth, *even*, shining white. Gills rounded behind, connected by veins, not much crowded, broad, forked with shorter ones intermixed, shining white.

"Allied to *R. vesca* in its *mild*, pleasant *taste*, and in other respects, but constantly different in the color of the pileus, which is very variable, whereas in *R. vesca* it is unchangeable. The peculiar combination of colors in the pileus, though very variable, always readily distinguishes it. In woods, etc. Common. August to October. Sometimes considerably larger than Fries describes. Name, κύανος, blue; ξανθός, yellow. From the colors. (Fr., Monogr., ii, p. 194; B. and Br., n. 1131; C. Hbk., n. 626; S. Mycol. Scot., n. 597; Ag. Schæff., t. 93; Krombh., t. 67, f. 16–19; Paul., t. 76, f. 1–3.)"—Stevenson.

"One of the best esculent species. Spores 8–10 by 6–8μ." Sacc. Syll. "Intrinsically a margin with a rosy tone, more or less sobered with purple, a pale disk and between the two a dark zone of dull indefinable mixture of neutral green with purple, is the type, and the infinite variety is made up not of any change of colors, but simply of

their intensity."—Cooke. North Carolina and Pennsylvania. Common—Schweinitz.

20. "R. HETEROPHYLLA, Fr., Hym. Eur., p. 446; Stev., B. F., p. 123; Sacc. Syll., Vol. V, p. 465. Pileus very variable in color, but *never becoming reddish or purple*, fleshy, firm, convexo-plane, then depressed, *even polished*, the very thin pellicle disappearing, margin thin, even or densely but slightly striate; flesh white. Stem solid, firm, somewhat equal, *even* shining white. Gills *reaching the stem in an attenuated form, very narrow, very crowded*, forked and dimidiate, shining white. Taste *always mild*, as in *R. cyanoxantha*, from which it differs in its smaller stature, in the pileus being thinner, even, *never reddish* or purplish, with a thin, closely adnate pellicle, in the *stem* being *firm and solid*, and in the *gills* being *thin, very narrow, very crowded*, etc. The apex of the stem is occasionally dilated in the form of a cup, so that the gills appear remote. In woods. Common. July to October.

"Edible, of a sweet nutty flavor. Spores echinulate, 5 by 7μ."—W. G. S. "Name, *Ετερος*, other, *φύλλον*, a leaf. With *gills of different* lengths. Fr.,) Monogr., ii, p. 194; Berk. Out., p. 211, t. 13, f. 5; C. Hbk., n. 627; S. Mycol. Scot., n. 598; Hogg. & Johnst., t. 9; Hussey, i, t. 84; Badh., i, t. 10, f. 3; ii, t. 3, f. 3, 4; Ag. Gl. Dan., t. 1909, f. 1; Paul., t. 75, f. 1–5)."—Stevenson.

Of the same edible qualities as the preceding; sometimes of a greenish-gray color. *R. furcata*, the only species of a disagreeable flavor having a green pileus, is distinguished by its uniform color and distant gills, as contrasted with the mottled tints and crowded gills of the former. North Carolina and Pennsylvania, in moist woods (*A. lividus*, Pers.) Schweinitz; California, Harkness and Moore; New York, in woods, August, Peck Thirty-fifth Report; Massachusetts, Palmer.

21. "R. CONSOBRINA, Fr., Hym. Eur., p. 447; Stev., B. F., p. 123; Sacc. Syll, Vol. V, p. 466. Pileus 3 inches (7.5 centimeters) broad, *dark-cinereous* or fuscous-olivaceous, fleshy, fragile, campanulate then expanded, at length depressed, margin spreading, even, though membranaceous; *flesh—white, cinereous, under the thick, viscous*, separable *pellicle*. Stem 2–3 inches (5–7.5 centimeters) long, almost 1 inch (2.5 centimeters) thick, solid, but *soft*, equal, even, smooth, shining, white, *at length becoming cinereous*. Gills at the first free, then appearing adnate when the pileus is flattened, broad, crowded, shining, white, *very many of them dimidiate and forked*. *Taste very acrid*. Not fetid. Stature in general that of *R. emetica*, but differing in the color of the pileus, and in the very unequal gills. In mixed woods. October. Spores granular 10μ. Q. Name—*consobrinus*, cousin. Distantly related to neighboring species. (Fr., Monogr., ii, p. 195; B. & Br., n. 1676; S. Mycol. Scot., n. 599.)"—Stevenson.

New York. "Our specimens are very variable in color, but the prevailing hues are green, olivaceous, and purple."—Peck. Twenty-sixth Report.

22. "R. FŒTENS, (Pers.) Fr., Hym. Eur., p. 447; Stev., B. F., p. 124; Sacc. Syll., Vol. V, p. 467. Pileus 4–5 inches (10–12.5 centimeters) and more broad, dingy yellow, often becoming pale, thinly fleshy, at first bullate, then expanded and depressed, covered with a pellicle which is adnate, not separable and viscid in wet weather, margin broadly membranaceous, at first bent inwards *with ribs which are at length tubercular;* flesh thin, *rigid*—fragile, pallid. Stem 2 inches (5 centimeters) and more long, ½–1 inch (1–2.5 centimeters) thick, stout, stuffed, then hollow, whitish. Gills adnexed, crowded, connected by veins, with very many *dimidiate and forked* ones intermixed, whitish, at first *exuding watery drops.*

"Fetid. *Taste acrid.* Very *rigid,* most distinct from all others in its *very heavy empyreumatic odor.* In very dry weather the odor is often obsolete. The margin is more broadly membranaceous and hence marked with *longer furrows* than in any other species. It differs from all the preceding ones in the gills at the first exuding watery drops. The gills become obsoletely light yellow, and dingy when bruised."—Stevenson. "In woods, etc. Very common. July to September. Stem ruggedly hollow within as if eaten by snails."—M. J. B. "A very coarse and easily recognized species. Reckoned poisonous, though eaten by slugs. Spores minutely echinulate, almost globular 8μ."—W. G. S. "Name—*fœtens,* stinking. (Fr. Mongr., ii, p. 195; Sv. ätl. Sv., t. 40; Berk. Out., p. 213; C. Hbk., n. 628; S. mycol. Scot., n. 600; Ag. Pers.—Krombh., t. 70, f. 1–6; Viv., 41; Bull., t. 292; Ventur., t. 33, f. 1–3.)"—Stevenson.

"Variety *granulata* has the cuticle of the pileus rough with small granular scales."—Peck, Thirty-ninth Report. "The odor of this plant as it occurs with us is not usually fetid or unpleasant. It resembles the odor of cherry bark and might aptly be termed amygdaline, and the same odor has been attributed by one writer at least to the European *R. fœtens.* It is doubtless this form to which Dr. Curtis gave the name *R. amygdalina.* The lamellæ are rarely forked and frequently are quite as equal as in species of the section Fragiles."—Peck, Thirty-second Report.

North Carolina and Pennsylvania, plentiful, August, Schweinitz; North Carolina, Curtis; Massachusetts, Sprague, Frost; New York, common in woods and open places, July and August, Peck, Twenty-third Report; Minnesota, July to September, Johnson; Wisconsin, Bundy; Ohio, generally rancid and stinking, sometimes fragrant, common, Morgan; Rhode Island, Bennett.

23. "R. SIMILLIMA, Peck, 24th Rep. N. Y. State Mus. Nat. Hist., 1872, p. 75; Sacc. Syll., Vol. V, p. 467; pileus, 1–3 inches (2.5–7.5 centimeters); broad, hemispherical or convex, then expanded, slightly depressed; at first or when moist viscid; the margin at length tuberculate-striate; pale, ochraceous yellow, the disk usually a little brighter colored; gills subequal, reaching the stem, some of them forked behind, venose connected, yellowish from the first; stem 2–4 inches (5–10 cen-

timeters) long, $\frac{1}{3}$–$\frac{3}{4}$ inch (8–18 millimeters) thick; equal or slightly tapering upward, spongy within, rarely hollow, colored like the pileus, sometimes a little paler; spores, $\frac{1}{3000}$ inch (8 μ) in diameter; taste acrid. Ground in woods."—Greig. September.

"Allied very closely to *R. fœtens*, from which it differs by the absence of any marked odor and the margin not so widely striate. I have never seen it cæspitose; not growing in cleared lands."—Peck. Massachusetts, Frost; Wisconsin, Bundy.

24. "R. MORGANI, Sacc. Sylloge, Vol. V, p. 468. (*R. incarnata*, Morgan.) Pileus 3–4 inches (7.5–10 centimeters) broad, fleshy, firm; then very fragile, convexo-umbilicate; then expanded and depressed, moist, sordid, flocculose; the margin acute, not striate; the flesh thin, white. Stem about 2 inches (5 centimeters) long, $\frac{3}{4}$ inch (18 millimeters) thick, solid, nearly equal, white. Gills adnate, distant, broad, and alternate ones dimidiate or mostly very short, white, then pale flesh color. Spores white, oblique, apiculate, smooth; 8–5.5 μ.

"Taste mild. On the ground, under beech trees. July, August. The pileus is at first of a sordid color, brownish on the disk. The whole plant when mature takes on a sordid, fleshy hue, and becomes exceedingly fragile."—Morg.

Originally published as *R. incarnata* by Prof. A. P. Morgan in The Mycologic Flora of the Miami Valley, Ohio, (Journ. Cinn. Soc. Nat. Hist., April, 1883), but the title being preoccupied it was renamed as above.

25. "R. VARIATA, Miss M. E. Banning, Bot. Gaz., Jan., 1881. Pileus 3–4 inches (7.5–10 centimeters) broad, at first globose, then expanded and centrally depressed, smooth, viscid, variable in color and even variegated brownish or pinkish purple, with at times a cast of green; epidermis peels easily; the extreme under margin edged with a delicate line of purple; flesh white, unchanging. Gills white, adnexed, narrow, forked, close. Stem nearly 2 inches (5 centimeters) long, $\frac{3}{4}$ inch (18 millimeters) thick, white, smooth, more or less tapering at the base, spongy within; spores white, echinulate, 7.5 by 7.5 μ. Taste acrid. In woods near Baltimore. July."—Ban.

(*To be continued.*)

A NEW MUCRONOPORUS.

(Plate XII.)

By J. B. ELLIS AND B. T. GALLOWAY.

MUCRONOPORUS EVERHARTII. On living trunks of *Quercus nigra*, around Newfield, N. J. Found also by Mr. Everhart at West Chester, Pa., and sent from northern New Jersey by Prof. T. G. Gentry. Pileus dimidiate, zonate unguliform, broadly attached behind, convex above,

nearly plane below or convex behind and subconcave towards the margin, 6–12 centimeters wide and 6–8 centimeters long; margin subobtuse and clothed with a rich dark rhubarb-yellow thin tomentum, at length subglabrous. Pileus with 3–4 broad (2 centimeters) convex zones, the anterior margin of each zone disappearing beneath the posterior margin of the one before it, forming a concentric furrow between each two contiguous zones; surface crustaceous but not polished, becoming brownish black. Pores rhubarb-yellow with a changeable luster, equal, round, 110–120 μ in diameter, about 1 centimeter long, substratose, armed with abundant stout spines, 15–25 by 6–10 μ, mostly swollen at the base. Spores ferruginous, globose 3–3½ μ, or ovate-globose 3½–4½ by 3–3½ μ. Substance of the pileus (above the pores) corky leathery, rhubarb-yellow, repeatedly zoned, 2–3 centimeters thick, holding its thickness well towards the margin. The pores are not decurrent but are limited behind by a narrow definite margin; closely attached to the bark of the tree. What appears to be the same was found some years ago at Potsdam, N. Y., on beech. This differs from *Fomes rimosus*, Berk. in its pileus not rimose, in its rather smaller spores and spiny hymenium. In *M. igniarius* the spines are less abundant and shorter and spores hyaline.

NEW SPECIES OF KANSAS FUNGI.

By J. B. Ellis and W. A. Kellerman.

Phyllosticta viridis, *n. s.* On leaves of *Fraxinus viridis*, Rooks County, Kansas, September, 1888; (E. Bartholomew, 185). On large subindefinite (½–1 centimeter) spots visible on both sides of the leaf with a paler shaded margin. Perithecia hypophyllous, numerous, suberumpent, small, 65–80μ, of rather coarse cellular structure; sporules abundant, oblong, minute (2 by ½μ). The spots much resemble those of *P. fraxini*, E. & M., but that has sporules 5–7 by 2½–3μ and much larger epiphyllous perithecia.

Cytispora albiceps, *n. s.* On bark of *Juglans nigra*, Manhattan, Kans., March, 1889 (Kellerman & Swingle, 1393). Tubercles semi-emergent, gregarious, ½ to ¾ millimeter, depressed-conic, opening by a single pore at the obtuse apex, which is covered with white granular matter, 5–6-celled, the cells at first filled with white granular matter and not readily distinguished. Sporules allantoid 4–7½ by 1¼–2μ. Basidia? Much resembles *C. leucophthalma*, B. &. C., but the specimens of that species in Rav. F. Am., 698, have the tubercles less prominent and smaller and the sporules smaller (3-4 by 1μ). This also differs from *C. persicæ*, Sz., and *C. leucostoma*, Sacc.

Ascochyta sisymbrii, *n. s.* On *S. canescens*, Manhattan, Kans. (Kellerman & Swingle, 1221). Spots none; Perithecia scattered on

both sides of the leaf and on the petioles, black, innate, globose-depressed, 200–285μ in diameter, 100–195μ high, pierced above with an aperture about 20–25μ in diameter. Sporules vermiform-cylindrical, subhyaline, nucleate and mostly 1-septate, 18–45 by $3\frac{1}{2}$–6μ, mostly 25–38 by 4–5μ. Not to be confounded with *Septoria sisymbrii*, Ell., which is on spots and has smaller spores.

SEPTORIA APARINE, *n. s.* On the lower dead and withered leaves and stems of *Galium aparine*, Manhattan, Kans., May, 1888 (Kellerman & Swingle, 1223). Perithecia minute, mostly 40–80μ but sometimes 160–208μ in diameter, scattered on the leaves and stems but not on spots. Sporules filiform, straight or subundulate, faintly nucleolate, continuous, acute at each end, 40–80 by $1\frac{1}{2}$–2μ mostly 50–60 by 2μ. Differs from *S. psilostega*, E. & M., in not being on spots and in its shorter sporules and from *S. galiorum*, Ell. in its partially foliicolous growth, smaller perithecia and much longer spores.

AMEROSPORIUM SUBCLAUSUM, *n. s.* On fallen leaves of *Gymnocladus Canadensis*, May, 1888 (Kellerman & Swingle, 1232). Amphigenous, scattered; perithecia black, ovoid-globose 90–150μ in diameter, of coarse cellular structure with a round opening above fringed with spreading brown septate hairs, 60–220 by 5–8μ tapering above. Sporules oblong-cylindrical, obtuse, continuous, hyaline, 10–13 by 2–3μ. Differs from *A. polynematoides*, Speg. in the character of the perithecia.

PESTALOZZIA UNCINATA, *n. s.* On dead leaves of *Quercus tinctoria* dried up on broken limbs, St. George, Kans., June, 1888 (Kellerman & Swingle, 1269), with *Chætophoma maculosa*, Ell. & Morgan. Hypophyllus, gregarious, perithecia scutate, $\frac{1}{4}$ to $\frac{3}{4}$ millimeter in diameter. Spores oblong, pale, 4-septate, sometimes constricted at the second septum above, 18–22 by 5–7μ, with a short (5–7μ), stout, curved beak at the apex and a slender pedicel below 15–20μ long. Differs from *P. pallida*, E. & E., in its larger perithecia and spores.

BOTRYTIS HYPOPHYLLA, *n. s.* On living leaves of *Teucrium Canadense*, Manhattan, Kans., October, 1884 (M. A. Carleton, 142). Forming small white patches at first, soon effused over the entire lower surface of the leaf like a white tomentum. Prostrate hyphæ loosely interwoven, branching; fertile hyphæ erect, 30–150 by $2\frac{1}{2}$–3μ, continuous, hyaline, subverticillately or rarely dichotomously branched above, the tips muriculate-lobate and bearing the globose $3\frac{1}{2}$–$4\frac{1}{2}\mu$ conidia. *Cercospora ferruginea*, Fckl. occurs on the same leaves.

BOTRYTIS CINEREO-GLAUCA, *n. s.* On wood under the bark of decayed logs of *Ulmus Americana*, Manhattan, Kans., March, 1889 (Kellerman & Swingle, 1422). Forming a cinereous and somewhat glaucous continuous layer on the decaying wood under partially adhering bark. The repent hyphæ are branched and loosely interwoven, 2–$2\frac{1}{2}\mu$ wide, septate, sometimes slightly swollen above the septa, varying from nearly hyaline to somewhat dusky. Fertile hyphæ erect, 75–100 by $1\frac{1}{2}$–$2\frac{1}{2}\mu$ wide, hyaline or somewhat dusky at base, at first sparingly and

later abundantly and irregularly branched, the branches usually straight and slightly tapering upward, terminated by a small cluster of oval-oblong 3–5 by $1\frac{3}{4}$–$2\frac{1}{4}\mu$ hyaline conidia.

OVULARIA CARLETONI, *n. s.* On *Lactuca*, Mitchell County, Kans., June, 1886 (M. A. Carleton, 141). Hypophyllous forming patches more or less distinctly limited by the veinlets 2–4 millimeters in diameter and of a pale yellowish color. The leaf is also marked on the upper side with pale yellowish indefinite spots. Hyphæ hyaline, 25–35 by 4–5μ, with offsets or shoulders on the sides marking the points where the conidia were attached, closely aggregated in minute tuberculiform masses. Conidia oblong-elliptical, hyaline, continuous, 12–15 by 6–7μ.

CERCOSPORA BARTHOLOMEI, *n. s.* On *Rhus toxicodendron*, Rooks County, Kans., September, 1888 (E. Bartholomew, 183 and 248*a*). Hypophyllous in inconspicuous, indeterminate, smoky-colored, scattered or subconfluent patches. Hyphæ fasciculate, straight or subundulate, nucleate, continuous or sparingly septate, reddish brown (under the microscope) 20–40 (mostly 24–34) by 4–6μ sometimes branched from near the base, tips entire or subdentate. Conidia nearly hyaline, varying from oblong to slender obclavate and from 20–120μ long and $2\frac{1}{2}$–3μ wide, nucleate becoming 3–8-septate, the shorter ones straight, the longer ones a little curved. This is very different from *C. toxicodendri*, Ell.

MACROSPORIUM BACCATUM, *n. s.* On old nuts of *Æsculus arguta*, Manhattan, Kans., March 1888 (Kellerman & Swingle 1239). Forms a dark olive thin but compact velvety coat on the nut. Fertile hyphæ sparingly branched or simple; torulose, 5–8μ in diameter, the joints occasionally swollen at intervals, nucleate. Conidia terminal, composed of rather loosely aggregated sub-globose cells, having an irregularly lobulated outline, somewhat resembling the fruit of a blackberry, very variable in shape and size, 16–40 by 8–27μ, usually without pedicels.

ZIGNOELLA DIAPHANA, (C. & E.). Sacc. var GRACILIS, *n. var.* On decayed log, Manhattan, Kans., June, 1888 (Kellerman & Swingle 1249). The sporidia are acutely elliptical, 3–4-nucleate, hyaline 11–$12\frac{1}{2}$ by 5–6μ, and like those in our specimens of *Z. diaphana* (although Saccardo, in Syll. II, 220, gives the size as 20 by $7\frac{1}{2}\mu$), but the asci, which are 75–87 by 6–9μ, are larger; and the perithecia, which are mostly 120–240μ in diameter, and globose-conic or subrostrate, are smaller and more acute. Possibly it should be assigned specific instead of varietal rank.

NEW AND RARE SPECIES OF NORTH AMERICAN FUNGI.

(*Sphæropsideæ.*)

By J. B. Ellis and B. M. Everhart.

Phyllosticta pyrolæ, *n. s.* On living leaves of *Pyrola rotundifolia*, Centreville, Del., July, 1873. A. Commons, 906. Spots amphigenous reddish brown, orbicular with a narrow, slightly raised margin, 1½–2 millimeters in diameter. Perithecia epiphyllous, erumpent, globose, 100–112μ in diameter. Sporules ovate-globose, hyaline, 5–6μ in the longest diameter.

Phyllosticta humuli, Sacc. & Speg. var. major, E. & E. On hop leaves, Iowa, June, 1889, A. S. Hitchcock. Differs from the type in its larger (12–16μ) sporules. Spots dull rusty white, becoming whiter, 2–3 millimeters in diameter, suborbicular, with a narrow, raised border. Perithecia epiphyllous, innate, yellowish, (80-90μ). Sporules 12–16 by 4–5μ with 1–3 nuclei.

Phyllosticta rhei, *n. s.* On *Rheum officinale*, Newfield, N. J., August, 1889. Spots mostly marginal, subconfluent, large (1–2 centimeters), rusty brown, concentrically zoned, either with or without a definite, slightly darker limiting line, around which is a broad border of light yellow. Perithecia innate, visible on both sides of the leaf and slightly prominent, rather large (100–150μ), not abundant. Sporules oblong-elliptical, 2-nucleate, rounded at the ends, hyaline, 5–7 by 2–2½μ, resembling the sporules of some *Phoma*.

Phyllosticta variegata, *n. s.* On leaves of *Fraxinus*, London, Canada, July, 1889. J. Dearness, 519. Spots numerous, angular, pale yellow, 1–3 millimeters in diameter, with a definite, narrow, darker margin. Perithecia epiphyllous, lenticular, black, 90–100μ. Sporules ovate or elliptical 4–5 by 1½–2μ. *Phyllosticta fraxini*, E. & M., which is doubtfully distinct from *P. fraxinicola*, Curr., has larger sporules (5–7 by 3μ) and larger darker spots. *P. viridis*, E. & K., is also quite different from this.

Phyllosticta macluræ, *n. s.* On leaves of *Maclura aurantiaca*, Newfield, N. J., August, 1889. Spots dark red-brown, subirregular and subindefinite, often marginal and confluent, ½ to 1 centimeter in diameter. Perithecia epiphyllous, prominent, ⅓ millimeter in diameter. Sporules ovate-oblong or fusoid-oblong 2–4-nucleate 10–12 by 3μ.

Phyllosticta calaminthæ, *n. s.* On *Calamintha clinopodium*, London, Canada, August, 1889. J. Dearness, 372. Spots amphigenous, definite, round 1–2 millimeters in diameter, nearly black, becoming whitish, thin. Perithecia few lenticular, epiphyllous, pierced above, 80μ in diameter. Sporules elliptical, hyaline, 2-nucleate, 3½–4½ by 2–2¼μ.

Phyllosticta hydrangeæ, *n. s.* On leaves of *Hydrangea* (cult.). Spots 1½ to 1 centimeter or more in diameter, rusty brown, with a nar-

row raised border, shaded with purple at first. Perithecia epiphyllous, lenticular, pierced above 100–115μ in diameter. Sporules oblong, 2–3-nucleate, hyaline, 10–12 by 2½–3½μ.

PHYLLOSTICTA ORONTII, E. & M. var. ADVENA, E. & E. On leaves of *Nuphar advena*, London, Canada, July, 1889. J. Dearness, 293½. Spots subelliptical 1–1½ centimeters, pale yellow, more or less concentrically wrinkled, with a narrow, definite, slightly raised border. Perithecia epiphyllous, innate, dark, slightly prominent, on a lighter colored, thinner, definitely margined spot in the center of the larger spot. Sporules oblong, 5–8 by 2½–3μ, ends obtuse.

PHYLLOSTICTA HALSTEDII, *n. s.* On living leaves of *Syringa vulgaris*, New Brunswick, N. J., July, 1889. Dr. B. D. Halsted. Spots amphigenous; subrotund; red-brown; ¼ to 1¼ centimeters in diameter; concentrically wrinkled or zoned, with a definite, narrow, dark border. Perithecia few; lenticular 100–150μ, in diameter; innate; generally visible on both sides of the leaf. Sporules broad, fusoid-oblong, not curved; granular; 15–20 by 5–7μ; ends rounded. The specimens of *Phyllosticta syringæ*, West, in De Thümen's Mycotheca 1490 agree very well with the description in Sylloge, having sporules 6–8 by 2½–3μ, but specimens in Fungi Gallici 135 are the same as the New Jersey specimens; spots concentrically wrinkled, and sporules 15–20 by 5–7μ. De Thümen's Mycotheca, 1672, on leaves of *Syringa Chinensis*, does not seem to be a *Phyllosticta*.

PHYLLOSTICTA DESMODII, *n. s.* On leaves of *Desmodium*, Walworth County, Wis. July, 1888. Dr. J. J. Davis, 47. Spots amphigenous, suborbicular or irregular; 2–5 millimeters in diameter; often more or less confluent; dark brown, becoming whitish in the center, at length more or less fissured and cracked. Sporules oblong, elliptical, hyaline, 3½–5 by 1½–2μ.

PHYLLOSTICTA PALMETTO, *n. s.* On leaves of *Sabal palmetto*, Louisiana, April, 1886. (Langlois, 426 in part.) On the same host at Leland, Miss., April, 1889 (Tracy, 1206). Spots subelliptical ½ to 1 by ¼ to ½ centimeter, pallid, with a yellowish shaded border. Perithecia amphigenous, pustuliform, 110–150μ in diameter, lead colored, of fine cellular structure, with a small round opening in the center. Sporules cylindrical; obtuse 2–3-nucleate, hyaline, 12–14 by 2½–3μ. The perithecia resemble minute blisters. Probably the spermogonial stage of *Sphærella sabaligena*, E. & E., with which it was mixed in the Louisiana specimens.

PHYLLOSTICTA DEUTZIÆ, *n. s.* On leaves of *Deutzia* (cult.). Spots amphigenous, light brown or whitish, round, 1–2 millimeters in diameter, with raised border on both sides of the leaf. Perithecia lenticular, black, mostly epiphyllous, nearly superficial, ⅕ millimeter in diameter. Sporules subelliptical, fuscous, 4–5 by 3μ.

PHYLLOSTICTA COMMONSII, *n. s.* On leaves of *Pæony*, Wilmington, Del., June 24, 1889. A. Commons, No. 922. Spots pale yellowish, defi-

nite, 3–4 millimeters in diameter. Sporules oblong or elliptical, smoky hyaline, 4–5 (exceptionally 6–7) by 2–2½μ. Differs from *P. pæoniæ*, S. & S., in its definite spots and smaller (75–80μ) perithecia and in its smaller sporules.

MACROPHOMA SUBCONICA, *n. s.* On dead stems of *Solanum nigrum*. St. Martinsville, La., November, 1888. Rev. A. B. Langlois, 1569. Perithecia innate-erumpent, conical, ½ to 1 millimeter high. Sporules elliptical, hyaline, 20–2? by 14–16μ. On slender basidia about as long as the sporules. Also on *Alocasia esculenta*, No. 1576.

PHOMA MEDIA, *n. s.* On dead stems of *Asparagus*, Newfield, N. J., April, 1889. Perithecia occupying an elongated spot 6–8 centimeters long and 1 centimeter wide, large (½ millimeter), depressed-globose, or slightly oblong, with a distinct papilliform ostiolum which is soon broadly perforated. Sporules fusoid, straight, hyaline, 2-nucleate, acute, about 10–12 by 2½μ. *P. asparagi*, Sacc., is on bleached parts of the stem and has smaller obtuse sporules. In this the surface of the stem beneath the leaden-colored epidermis is more or less blackened. *P. lanceolata*, (C. & E.) has the sporules 20–24 by 5μ.

SPHÆRONEMA CANUM, *n. s.* On dead branches of *Negundo aceroides*, Manhattan, Kans., February, 1889. Kellerman & Swingle, 1318. Perithecia at first covered by the bark, depressed hemispheric, 1 millimeter or over in diameter, with a central, cylindrical, stout, straight, black beak about 1 millimeter high with a slightly enlarged, subovate, gray, strigose head. Sporules ovate-olong or ovate-elliptical, nucleate, hyaline, 7–10 by 3–4μ, on cylindrical basidia 15–20 by 2μ, and forming a compact, whitish horn-colored stratum within the perithecia. The general appearance of the fungus is much like that of *Stilbum giganteum*, Pk., or perhaps resembles more closely *Sphæronema pruinosum*, Pk., but this is quite distinct from either of those species.

HAPLOSPORELLA EUONYMI, *n. s.* On dead limbs of *Euonymus atropurpureus*, Lincoln, Nebr., March, 1889; H. J. Webber. Stromata scattered or seriate, erumpent, and loosely surrounded by the ruptured epidermis, hemispheric or oblong, 1–2 millimeters in diameter, subtruncate, and finally whitish above. Perithecia entirely inclosed in the stroma, with thin subevanescent walls, and appearing on a cross-section more like cells than like perithecia; ostiola obscurely papilliform. Sporules oblong, obtuse, very slightly narrowed in the middle (possibly becoming 1-septate), 10–14 by 6–8μ, brown, on slender basidia, 70–80μ, long. On the smaller twigs the stromata are smaller, but the sporules larger, 18–22 by 10–12μ. *Sphæropsis valsoidea*, (C. & E.) has exactly the same structure and should be *Haplosporella valsoidea*, C. & E.

HAPLOSPORELLA AILANTHI, *n. s.* On dead *Ailanthus glandulosus*, Lyndonville, N. Y., May, 1889; Dr. C. E. Fairman, 61. Perithecia large (¾ millimeter); aggregate cespitose, buried in the bark and connected by an imperfect stroma, subseriately erumpent. Sporules ovate or elliptical, dark brown, 18–22 by 8–10μ, filled with white grumose matter.

ASCOCHYTA SILENES, *n. s.* On leaves and stems of *Silene antirrhina*, Racine, Wis. June 1888, Dr. J. J. Davis, 23, and on the same host collected by Mr. F. W. Anderson (No. 350) in Montana. Spots pale yellowish, the entire leaf finally assuming the same color, the spots which are then hardly discernible becoming paler. Perithecia erumpent discoid, 120–150μ in diameter, broadly pierced above, not confined to the spots but scattered over the entire leaf. Sporules oblong, hyaline, 2–3 nucleate, rounded at the ends 10–14 by 2½–3μ. In the Wisconsin specimens *Septoria saponariæ*, (D C.) occurs also on the same leaves, but may be distinguished with the naked eye by its paler perithecia. This differs from *Phyllosticta nebulosa*, Sacc., in its larger scattered perithecia and larger sporules. The specimens of *P. nebulosa* in Saccardo's Mycotheca Veneta (in our copy) are a *Sphærella* with clavate-oblong, inequilateral 35 by 15μ asci and crowded, oblong-fusoid 1-septate 12–15 by 3–3½μ sporidia.

ASCOCHYTA? INFUSCANS, *n. s.* On leaves of *Ranunculus* (*abortivus?*), London, Canada, July 18, 1889; J. Dearness, 256. On large, dark brown, indefinitely limited areas of the leaf, causing faintly zonate indefinite spots, in which are buried the brown perithecia, slightly raising the surface of the leaf in a pustuliform manner. Sporules oblong, hyaline, obtuse, narrowed in the middle, with two large nuclei 10–15 by 4–6μ (becoming uniseptate?).

ASCOCHYTA THASPII, *n. s.* On leaves of *Thaspium barbinode*, London, Canada, August, 1889; J. Dearness, 511. Spots amphigenous, suborbicular, dirty brown, with definite margin, surrounded by a narrow yellow border, about 1½ centimeters in diameter. Perithecia innate, pale, 100–120μ in diameter, entirely buried in the substance of the leaf and scarcely visible. Sporules cylindrical 1-septate (3–4 nucleate), 25–30 by 6–8μ, ends rounded and obtuse.

ASCOCHYTA ALISMATIS, *n. s.* On leaves of *Alisma plantago*, London, Canada, August, 1889; J. Dearness, 512. Spots amphigenous, round, small (1–2 millimeters). dirty brown, whitish in the center, surrounded by a faint yellowish discoloration. Perithecia innate, pale, 80–100μ, with a broad opening above. Sporules oblong cylindrical, 12–16 by 2½–3μ, 2–nucleate becoming 1-septate.

ASCOCHYTA CORNICOLA, Sacc. This seems to be quite variable in the size of the sporules. Saccardo says 7–10 by 3½–4μ. Specimens on leaves of *Cornus sericea* sent from Wisconsin by Dr. J. J. Davis have sporules 7–11 by 5–6μ. Specimens from Ohio sent by Professor Morgan have sporules 10–15 by 3½–4μ. *Phyllosticta cornicola* does not differ in any respect, except that the sporules are not septate, and is probably a less perfectly developed state of *Ascochyta cornicola*.

ASTEROMA RIBICOLUM, *n. s.* On living leaves of *Ribes floribundum*, Helena, Mont., August, 1888; Rev. F. D. Kelsey, No. 210. Epiphyllous. Fibrils branching and radiating from a central point, forming

dark-colored orbicular spots 1 centimeter or more in diameter. The lower surface of the leaf opposite is also of a darker color. The fibrils are closely appressed, and except towards their vanishing extremities are thickly covered with the minute black sterile perithecia.

CONIOTHYRIUM CEPHALANTHI, *n. s.* On living leaves of *Cephalanthus*, Bayou Chene, La., October, 1888; Langlois, 1532. Spots large, suborbicular, or irregular; grayish-brown above, rusty brown below; often subconfluent over a large part of the leaf, all more or less distinctly concentrically zoned. Perithecia hypophyllous, minute, abundant, erumpent, black. Sporules brown, continuous, globose, 4–5μ in diameter, or ovate, 4–5 by 3–3½μ.

SPHÆROPSIS SMILACIS, *n. s.* On dead stems of *Smilax hispida*, Lincoln, Nebr., November, 1888. H. J. Webber, 34. Perithecia scattered, buried in the substance of the bark, bursting the cuticle, but only partially erumpent. Sporules oblong, brown, obtuse, 15–20 by 6–8μ.

SPHÆROPSIS CLADONIÆ, *n. s.* On apothecia of *Cladonia cariosa*, Emma, Mo., March, 1889. Rev. C. H. Demetrio. Perithecia minute, about ⅛ millimeter in diameter, and a little more than that in height, obconic-cylindrical, subtruncate above. Sporules globose, or obovate-globose, yellowish-brown, about 3μ in diameter, on stout basidia about 6 by 2μ. Differs from *S. parasitans*, B. & Rav., in its differently shaped smaller perithecia and sporules.

HENDERSONIA HETEROPHRAGMIA, *n. s.* On dead twigs of *Sarcobatus vermiculatus*. Near Great Falls, Mont., July, 1889. F. W. Anderson, 541. Perithecia erumpent, superficial, subseriate, globose, collapsing, ⅜ millimeter in diameter. Ostiolum papilliform. Sporules elliptical or oblong elliptical, brown, 1–3-septate 12–16 by 5–7μ.

HENDERSONIA CONCENTRICA, *n. s.* On living leaves of *Rhododendron catawbiense*, Roan Mountain, North Carolina, July, 1889. Prof. F. L. Scribner. Spots exactly as in *Pestalozzia concentrica*, B. & C., marginal, 1–2 centimeter in diameter, variegated with alternate lighter and darker zones, margin definite, but not raised. Sporules fusoid-oblong, pale-brown, 3-septate, 12–15 by 3μ, on slender basidia 20–30μ. long. Acervuli mostly erumpent above, black. On *Rhododendron maximum* from the same locality, the fungus occurred on large dead areas of the leaf, and the concentric zones were scarcely discernible.

HENDERSONIA DAVISII, *n. s.* On partly dead leaves of *Carya alba*, Racine, Wis., August, 1888. Dr. J. J. Davis, 10. Spots large, occupying the entire upper half of the leaf, dark brown. Perithecia mostly epiphyllous, gregarious, black, erumpent ⅛ to ⅙ millimeter in diameter soon more or less buried by the exuding obovate-oblong, pale, olivaceous-black, 3-septate, 10–12 by 3–3½μ, sporules.

SEPTORIA LATHYRI, *n. s.* On dead leaves of *Lathyrus latifolious* (cult.), "Everlasting Pea," Newfield, N. J., March, 1889. Perithecia amphigenous, gregarious, prominent, mostly in groups, 2–4 millimeters

across; the leaf in these parts being slightly blackened. Sporules spiculiform, attenuated to a point at one end and subtruncate at the other, faintly nucleolate, 20–30 by $1\frac{1}{4}\mu$, mostly less than 25μ long. Differs from any of the four species on *Lathyrus* in the Sylloge in its shorter, spiculose sporules. *Septoria viciæ*, West, also has longer and thicker sporules. The general appearance is that of an erumpent *Sphærella*. Perhaps the spermogonia of *Sphærella lathyrina*, B. & C.

SEPTORIA INTERMEDIA, *n. s.* On *Solidago* (*juncea?*), Racine, Wis., June, 1888 (Davis No. 25). Spots small (1 millimeter), scattered, subconfluent dull-white, with a dark purple shaded border. Sporules nearly straight, hyaline, nucleolate 15–25 by $1-1\frac{1}{2}\mu$. Has the general appearance of *Septoria atropurpurea*, Pk., but is distinguished by its much shorter spores as well as different host.

SEPTORIA PHYSOSTEGIÆ, *n. s.* On leaves of *Physostegia Virginiana*, Racine, Wis., September, 1888. Dr. J. J. Davis, 4. Spots amphigenous, small (1 millimeter), dirty white, with a shaded purplish border. Sometimes several of the small white spots are included in a larger brown spot. Sporules filiform, nearly straight, 20–27 by $1-1\frac{1}{4}\mu$. *S. brunellæ*, Ell. & Holw. is on larger rusty brown spots and has longer sporules.

SEPTORIA ASTERICOLA, *n. s.* On *Aster cordifolius*, Magnolia, Mass. Miss Clarke; Delaware, Commons, 723 and 724; Wisconsin, Davis. Spots amphigenous, dark brown, subindefinitely limited, bounded by a broad yellow border, the brown central part 3–4 millimeters across. Perithecia innate, finally partially erumpent above, numerous, scattered, small (75μ), scarcely visible in the earlier stages of growth, light brown. Sporules slender, nearly straight, nucleate, 30–45 by $1-1\frac{1}{4}\mu$. Differs from *S. atropurpurea*, Pk. in its yellow bordered spots and shorter, narrower sporules.

SEPTORIA PRENANTHIS, *n. s.* On leaves of *Prenanthes*, Racine, Wis., August, 1888, Dr. J. J. Davis, 20. Spots scattered, suborbicular, dull white, with a purple border 2–3 millimeters in diameter, thin. Perithecia amphigenous, scattered on the spots, suberumpent, yellowish. Sporules filiform, slightly curved, continuous, 15–22 by $1-1\frac{1}{4}\mu$.

SEPTORIA ASCLEPIADICOLA. Jour. Mycol., IV, p. 44. The sporules are mostly only $1\frac{1}{2}\mu$ thick instead of $2-2\frac{1}{2}\mu$. The same thing has been sent from Missouri on *Asclepias rubra*, Demetrio, 215.

SEPTORIA COMMONSII, *n. s.* On leaves of *Cnicus altissimum*, Faulkland, Del., August, 1885. A. Commons, 137. Spots dark brown with a whitish center, round, 2–4 millimeters diameter, obscured below by the tomentum of the leaf. Perithecia epiphyllous, minute, clustered, black, subprominent. Sporules subspiculose, slightly curved, continuous, nucleolate, 25–40 by $1-1\frac{1}{4}\mu$. *S. cirsii*, Niessl., is said to have sporules 40–80 by $1\frac{1}{2}-2\mu$ and 8–12-septate. The specimens labeled *S. cirsii*, Niessl., in De Thümen's Austrian Fungi, 690, which are sterile, have the spots concentrically marked and have no white center.

SEPTORIA DEARNESSII, *n. s.* On *Archangelica atropurpurea*, London, Canada, August, 1889. Mr. J. Dearness, 552. Spots amphigenous, dark brown, irregular, angular, 1–5 millimeters in diameter. Perithecia innate, minute, slightly prominent, very obscure. Sporules issuing in white cirrhi, 15–22 by 1½μ, without nuclei or septa, nearly straight. Approaches *Cylindrosporium* on account of the imperfectly developed perithecia.

SEPTORIA DIVARICATA, *n. s.* On living leaves of *Phlox divaricata*, Lyndonville, N. Y., May, 1889. Dr. C. E. Fairman, 44. This is the *Septoria phlogis*, S. & S.? in Journ. Mycol., III, p. 85. The Lyndonville specimens agree exactly with the Iowa specimens so that there is reason to think this is not an immature state of *S. phlogis*, S. & S., but a different thing. In fact it differs throughout from the description of that species. The spots are not white, only whitish, and the sporules instead of being 40–60 by 1–2μ and 1–3-septate are 15–35 by 1μ, mostly 20–25μ long, nearly straight instead of flexuous, and very faintly nucleolate but not septate.

SEPTORIA FAIRMANI, *n. s.* On living leaves of Hollyhock (*Althæa rosea*), Lyndonville, N. Y., June, 1889. Dr. C. E. Fairman, 77. Spots amphigenous, scattered, subangular, 3–4 millimeters in diameter, dark brown and limited in part by the veinlets, border narrow and dark. Perithecia epiphyllous, rather numerous, scattered quite evenly over the spots, black, 100–112μ, subprominent. Sporules filiform, slightly curved, nucleate, 30–45 by 1½–2μ, hyaline. Whether *S. althææ*, Thüm., is different from this it is impossible to tell, as the specimen in his Austrian Fungi, 955, is a *Cercospora*. He says of this (F. Aust., 955) "perithecia arranged in a circle on dry pale brown spots," which applies very well to his specimen. Apparently De Thümen mistook the tufts of *Cercospora* for perithecia. In Dr. Fairman's specimen the spots are dark brown. *S. lachastreana*, Sacc. & Let. has the sporules 3-septate, and the perithecia are smaller and on minute whitened spots. On the same leaves is a *Phyllosticta* with oblong 3–4 by 1½–2μ sporules, on white deciduous spots of about the same size as those producing the *Septoria*. The *Phyllosticta* agrees with *P. althæina*, Sacc., only the sporules are smaller.

SEPTORIA CRYPTOTÆNIÆ, Ell. & Rau.? J. M., III, p. 50. Specimens collected in Delaware by Mr. Commons (910) enable us to add the following notes: Spots white, becoming brown, angular, limited by the veinlets. Perithecia epiphyllous, erumpent, black, depressed-globose, 100–120μ, scarcely visible below. Sporules filiform, yellowish, attenuated towards each end, faintly nucleolate, slightly curved 20–30 by 1¼–1½μ. The leaf turns yellow around the spots. Perithecia not abundant. This is closely allied to *S. ægopodina*, Sacc., which, however, has smaller perithecia. It is certainly very different from the specimen labeled *Septoria ægopodina*, Sacc. in Fungi Gallici, 1317. From *S. saniculæ*, E. & E. (J. M., IV, 44) it differs in its larger spots, perithecia, and sporules.

SEPTORIA CONVOLVULI, Desm. Prof. Hitchcock sends this from Iowa on *Calystegia sepium*. It is distinguished from *S. calystegiæ*, Desm. and *S. flagellaris*, E. & E. by its more numerous perithecia and larger spots, and from the latter also by its shorter (20–35μ) sporules.

SPHÆRONEMELLA CARNEA, *n. s.* On ash bark, Lake Skaneateles, New York, July, 1872. Rev. J. L. Zabriskie, 119. Perithecia gregarious, erumpent, flesh-colored, subulate, 2 millimeters long, swollen at the base, which contains the sporigenous nucleus. Sporules oblong, hyaline, continuous, about 15 by 4μ, rounded at the ends.

SPHÆRONEMELLA ROSÆ, *n. s.* On dead twigs and old calyx tubes of *Rosa lucida*, Newfield, N. J., June, 1889. Perithecia erumpent, membranaceous, ovate, yellowish, becoming black, about $\frac{1}{3}$ millimeter in diameter; narrowed above into a short, cylindrical, membranaceous, pale ostiolum, crowned with spherical yellow globule of exuded, narrow, elliptical, hyaline, continuous, $4\frac{1}{2}$–$5\frac{1}{2}$ by $2\frac{1}{2}$–3μ sporules. The perithecia are loosely bordered by the ruptured epidermis and white inside from the mass of sporules. This approaches *Cytispora*, but the perithecia are simple.

ASTERINULA nov. gen. of SPHÆROPSIDEÆ Fam. LEPTOSTROMACEÆ.

Perithecia dimidiate, scutelliform, submembranaceous, radiate-cellulose; sporules ovoid or oblong, 1-septate, hyaline. Differs from *Leptothyrium* in its uniseptate sporules, from *Asterina* in the absence of asci, and from *Ascochyta* in its superficial perithecia.

ASTERINULA LANGLOISII, *n. s.* On living leaves of *Magnolia grandiflora*, Louisiana, January, 1889. Rev. A. B. Langlois, 1656. Hypophyllous. Perithecia scattered or gregarious, not on any definite spots, dimidiate, superficial, radiate, cellulose, pierced above, 100–112μ in diameter mostly with a short fringe of brown mycelium around the margin. Sporules oblong or obovate-oblong 2-nucleate, becoming 1-septate, hyaline, 18–22 by 7–8μ, ends rounded and obtuse. Probably the spermogonial stage of some *Asterina*.

DIPLODINA RAMULORUM, *n. s.* On bleached stems of *Smilax* and *Lycium*, Newfield, N. J. Perithecia subcuticular, black, minute, gregarious. Sporules oblong, elliptical, smoky hyaline, 1-septate, 5–8 by 2–3μ.

DISCULA XANTHOXYLI, *n. s.* On dead stems of *Xanthoxylum*, St. Martinsville, La., January, 1889. Rev. A. B. Langlois, 1600. Perithecia gregarious, on bleached spots 2–3 centimeters long by $\frac{1}{2}$ centimeter broad, subdiscoid, about 150μ in diameter, of rather coarse cellular texture, with a small circular opening above. Immediately around this opening the perithecium is more compact and nearly opaque, but around this dark center it is thinner and translucent. Sporules abundant, oblong-cylindrical, hyaline, continuous, 12–20 by 3–$3\frac{1}{2}\mu$, arising directly from the cells of the proligerous layer, which are some-

times elongated and even imperfectly branched so as to form rudimentary basidia.

DISCULA RUNCINATA, *n. s.* On dead stems of *Stephanomeria runcinata*, Helena, Mont., January, 1889; Rev. F. D. Kelsey, 133. Gregarious or scattered, covered at first by the epidermis and then convex and closed, soon erumpent, and the upper part of the perithecia disappearing, leaving a broad opening above; of coarse cellular texture, 150–200μ in diameter. Sporules hyaline, continuous, oblong, curved, generally more strongly so at one end, 18–23 by 3½–4μ. The sporules and the perithecia also are those of a *Vermicularia*, only the hairs or bristles are wanting.

DISCELLA PILOSULA, *n. s.* On a decorticated maple, Lyndonville, N. Y., April, 1889, Dr. C. E. Fairman. Perithecia gregarious, ovate ⅓ to ½ millimeter in diameter, erumpent, superficial, black, rough, and sparingly clothed with short, spreading, pale, glandular hairs intermixed with a few black bristle-like hairs, at first closed, then with a broad opening above, the margin sublacerate dentate or subfimbriate. Texture of the perithecia subfibrous. Sporules cylindrical, curved, 3–6-nucleate and either continuous or faintly 1-septate, brownish-hyaline, 10–16 by 2–2½μ, the ends mostly abruptly mucronate-pointed and incurved. Basidia slender, simple, or sometimes branched, 25–30μ long. This would come better under *Amerosporium* but for the 1-septate sporules. The septum was only observed in the larger and more mature sporules and was then very faint, but there is no doubt of its presence, nor is it unlikely that after the specimens have lain in the herbarium a few years they may become three or more septate.

SPORONEMA PALLIDUM, *n. s.* On bleached spots on bare decaying wood of maple, Ridgeway, N. Y., May, 1889, Dr. C. E. Fairman, 58. Perithecia gregarious, erumpent, cespitose, ½ millimeter in diameter, multiradiate-cleft above or after the laciniæ have disappeared, irregularly lacerate-cleft; at first closed. Sporules concatenate, 8–10 by 2μ, sub-cylindrical, hyaline, formed by constriction of the sporogenous filaments.

GLŒOSPORIUM REVOLUTUM, *n. s.* On living leaves of *Robinia pseudácacia*, Newfield, N. J., August, 1889. Mostly on leaves of the terminal shoots. The margin of the leaf becomes yellowish green and revolute, then brown and dead. The oblong 12–15 by 3–4½μ spores begin to ooze out from the buried acervuli as the affected part begins to turn brown, soon becoming confluent and forming a flesh-colored coating on the surface of the leaf. In the early stage of growth the fungus has the aspect of a *Taphrina*.

GLŒOSPORIUM CANADENSE, *n. s.* On living leaves of white oak, London, Canada, July, 1889; J. Dearness, 193. Spots amphigenous, irregular, subrotund, about ½ centimeter in diameter, pale rusty brown in the center, with a broad dirty brown border and tolerably definite margin above, more indefinite below. Acervuli scattered, be-

coming dark, 180–200μ in diameter. Mostly erumpent above. Spores ovate-oblong, hyaline 10–14 by $3\frac{1}{2}$–$4\frac{1}{2}\mu$. Possibly not distinct from *G. umbrinellum*, B. & Br., but that is said to have the spots "minute."

GLŒOSPORIUM HYSTERIOIDES, *n. s.* On orange leaves, Florida, 1886; Dr. George Martin. Spots large, mostly marginal, yellowish at first, then cinereous, and finally dirty white, border yellow, broad, and slightly elevated. Acervuli erumpent, black hysteriiform. Spores oblong, 12–15 by $3\frac{1}{2}$–5μ, not curved, basidia shorter than the spores. Spots 1–2 centimeters across, often extending along the margin of the leaf. Differs from *G. sphærelloides*, Sacc., in its short basidia and from *G. hesperidearum* in its definite spots.

GLŒOSPORIUM RAMOSUM, *n. s.* On leaves and stems of *Polygala polygama*, Newfield, N. J., June, 1889. Parts of the leaf at first turn dark purple and on these discolored places appear small, circular yellowish-white spots about 1 millimeter in diameter. In these spots are seated the innate acervuli, generally only one at first in the center of the spot, finally 2–4, slightly prominent and black above, appearing like the erumpent apex of a small perithecium, but the oblong-cylindrical, slightly curved, obtusely pointed, granular, continuous, 12–22 by 3–$3\frac{1}{2}\mu$ spores, on thick branching basidia, about as long as the spores themselves, are discharged below. This differs from the other species of *Glœosporium* in its branched basidia which much resemble the spores themselves. The fungus is very destructive to the plants, all the leaves soon turning pale-yellowish and falling off.

GLŒOSPORIUM (MARSONIA) BRUNNEUM, *n. s.* On leaves of *Populus candicans*, Newfield, N. J., August, 1889. Leaf mottled above with small black spots which soon become confluent in large areas, especially around the margin, the entire lower surface of the leaf soon assuming a uniform bronze-brown color. Acervuli 1–3 in each of the minute black spots, pale, erumpent on both sides of the leaf, finally nearly black. Conidia clavate obpiriform, hyaline, 1-septate below the middle, 14–16 by 5–7μ. On account of the smaller conidia and different habit this seems sufficiently distinct from *G. populi* and *G. castagnei*. There are no well defined spots, only the small black specks soon confluent and blackening finally the greater part of the leaf.

GLŒOSPORIUM (MARSONIA) GRAMINICOLUM, *n. s.* On living leaves of grasses, London, Canada, August, 1889. J. Dearness, 341. Spots amphigenous, black, subindefinite, 2–3 millimeters, becoming white in the center from the erumpent spores. Acervuli minute, buried, cirrhi white, minute. Spores cylindrical, 1-septate, 15–22 by 3–4μ hyaline. The leaf is slightly thickened at the spots.

PHLEOSPORA ACERIS, (Lib.). On leaves of *Acer dasycarpum*, Manhattan, Kans., July, 1887. W. T. Swingle. Dr. Winter has issued this in his Exsicc. (3480) under this name (see also N. A. F. Cent., XXIII). *Glœosporium acerinum*, Pass. in De Thümen's Mycotheca (93)

differs only in its rather shorter spores, which are also more distinctly thickened at one end. In both they are 3-septate.

GLŒOSPORIUM (SEPTOGLŒUM) AMPELOPSIDIS, *n. s.* On fading leaves of *Ampelopsis quinquefolia*, Racine, Wis., September, 1888, Dr. J. J. Davis, 69. Spots amphigenous, angular, limited by the veinlets of the leaf, 2–3 millimeters in diameter, greenish. Acervuli erumpent on both sides of the leaf, prominent. Spores clavate-cylindrical, 5–9-septate, 30–35 by 4–4½ μ.

GLŒOSPORIUM LAGENARIUM, Pass. var. MUSARUM, E. & E. On banana rind, Lincoln, Nebr., Roscoe Pound, 23, does not differ essentially from the forms on various species of *Cucurbitaceæ*. A foliicolous form of this species has proved very destructive around Newfield, N. J., this year on water-melon and musk-melon vines.

CYLINDROSPORIUM? OCULATUM, *n. s.* On leaves of *Populus monilifera*, Put-in-Bay, Ohio, August, 1888, Dr. J. J. Davis, 14. Spots amphigenous, round, 3–5 millimeters in diameter, grayish white, with a darker margin and a narrow raised border. Acervuli innate, amphigenous, yellowish (finally blackish), rather large (⅕ millimeter). Spores clavate-cylindrical, curved, 30–50 by 3μ nucleate (becoming 3 or more septate).

CYLINDROSPORIUM CLEMATIDIS, E. & E. J. M. III, p. 22. Mr. Galloway sends some leaves of *Clematis Jackmanii* collected at Geneva, N. Y., June 20, 1889, in which the tubercular masses of exuded spores are *black*, but the spores themselves are hyaline as in the original specimen on *C. Virginiana*. In the Geneva specimen the spots are less distinct and definite, and the acervuli are not confined to the spots, thus differing considerably from the original description. It may, however, be doubted whether the specimens on *C. Jackmanii* are specifically distinct, and we have for the present at least placed them as a variety, *C. clematidis*, E. & E., var. *Jackmanii*.

CYLINDROSPORIUM VIRIDIS, *n. s.* On living leaves of *Fraxinus viridis*, St. Martinsville, La., May, 1889. Langlois, 1712. Spots (on the upper side of the leaf) numerous, dark purple, suborbicular, 3–4 millimeters in diameter, with a subindefinite margin and a small (1 millimeter or less) rusty-brown center. On the lower surface of the leaf the purple color is entirely wanting, only dirty brown 1–2 millimeter subindefinite spots opposite the center of those on the other side. Acervuli innate, 3–6, in or near the center of the spots, prominent below, but opening above and discharging snow white heaps of cylindrical fusoid, 30–35 by 2½μ, nucleate spores curved nearly to a semicircle. The measurement is from tip to tip as the spores lie curved. Readily distinguished from *C. fraxini*, E. & K., by the purple spots and shorter spores. What appears to be the same, but without fruit, has also been sent from Ohio (Morgan, 405).

CYLINDROSPORIUM SACCHARINUM, *n. s.* On living leaves of *Acer*

saccharinum, Racine, Wis., October, 1888. Dr. J. J. Davis, 59. Spots amphigenous, numerous, scattered, subangular, minute (mostly about 1 millimeter in diameter), greenish black, becoming darker. Acervuli hypophyllous, minute, crowded in the spots, black above, so as to resemble minute perithecia. Spores slender-cylindrical, more or less curved, hyaline, granular, becoming faintly 3-septate, 30–40 by 2½–3μ erumpent in small white heaps which soon spread out into a small membranaceous patch like a minute white *Corticium*. This can not easily be mistaken for *Glœosporium aceris*, Cke. or *G. acerinum*, West.

HAINESIA BOREALIS, *n. s.* On *Galium boreale*, Hauiloops, British Columbia, July, 1889. Dr. John Macoun, 156. Acervuli hypophyllous, scattered, suborbicular, erumpent, ½ to ¾ millimeter in diameter, subgelatinous, yellowish-hyaline, depressed-hemispherical, with a narrow black linear margin formed from the ruptured epidermis of the leaf. Spores suballantoid, 5–7 by 1μ, faintly 2-nucleate, slightly curved, borne on fasciculate, more or less branched basidia, 20–25 by 1μ.

CRYPTOSPORIUM NUBILOSUM, *n. s.* On dead or partly dead leaves of *Carex* (*Pennsylvanica?*) Newfield, N. J., 1879. Sent also from Montana by Mr. Anderson (344) on an allied species of *Carex*. Acervuli innate, scarcely erumpent, black, 80–110μ in diameter, showing by translucence through the epidermis, gregarious in bands across the leaf or seriate. Sporules lunate-fusoid, 15–20 by 2½μ, *hyaline*, faintly nucleate.

NÆMASPORA MICROSPERMA, *n. s.* On bark of *Acer saccharinum*, London, Canada, August, 1889. J. Dearness, No. 562. Sporiferous cavities confluent for 1–2 centimeters between the laminæ of the bark, purplish-black, the minute, ovate, or elliptical 2–2½ by 1½–2μ spores bursting out in copious cherry-red masses and cirrhi through cracks in the bark. Differs from *C. difformis*, Sz., in its smaller spores on basidia, 12–15 by 1½μ.

PESTALOZZIA AFFINIS, *n. s.* On fallen leaves of "Japan Chestnut," Lafayette, La. Acervuli innate, erumpent, on both sides of the leaf, but more abundant below. Spores acutely elliptical, pale, 15 by 5μ (about 12μ) between the extreme septa, 4-septate, with a single oblique bristle about 7μ long at the apex and borne on a pedicel shorter than the spore. The spores ooze out in small black heaps, which are as usual often subconfluent-diffused. This differs from *P. pallida*, E. & M., in its broader spores and in lacking the *prominent septa* of that species.

PESTALOZZIA FLAGELLIFERA, *n. s.* On branches of *Comptonia asplenifolia*, killed by fire a few weeks ago, Newfield, N. J, June 10, 1889. Pustules numerous, subcuticular, raising the epidermis into little tuberculiform pustules which become slightly ruptured above and have a dark gray nucleus. Spores abundant, oblong, slightly curved 1-septate, yellowish-hyaline, 9–12 by 3μ, on stout basidia, about as long as the spores with a single long (25–35μ) undulate, hyaline bristle ris-

ing from one side of the apex. The spores are mostly a little narrower below and more acute.

PESTALOZZIA AQUATICA, *n. s.* On living leaves of *Peltandra Virginica*, Newfield, N. J., August, 1889. Spots amphigenous, chestnut brown ½ to 1 centimeter in diameter, concentrically wrinkled, border narrow, darker, acervuli epiphyllous, erumpent, ¼ to ⅓ millimeter in diameter, black, convex, then concave. Spores obovate, 18–20 by 6–7μ, 4-septate, end cells hyaline, next to the lower cell subhyaline, two next above dark. Crest of three stout (15–20 by 1μ) hyaline spreading bristles. What appears to be the same is found also on leaves of *Sarracenia purpurea.*

PESTALOZZIA NERVALIS, *n. s.* On veinlets of living white-oak leaf from which the parenchyma had been eaten away by some larva, Racine, Wis., September, 1888. Dr. J. J. Davis, 3. Acervuli subhysteriiform. Conidia narrow, elliptical or broad, oblong-fusoid, 4-septate, terminal cells hyaline, colored part (3 inner cells) about 14 by 6μ, lower hyaline cell 8–9μ, long, oblique bristle at the apex 8–9μ long.

PESTALOZZIA MAURA, E. & E. J. M. IV, p. 123. Mr. Langlois finds this at St. Martinsville, La., on dead leaves of *Persea Carolinensis* and on leaves of *Quercus virens* and *Q. palustris*, differing from the Florida specimens only in the absence of any spots, the innate erumpent acervuli being scattered irregularly over the leaf and mostly erumpent below. This species is well characterized by its obconic conidia, having the two cells next below the upper hyaline cell almost black.

BLACK SPOT OF ASPARAGUS BERRIES.

By CHARLES E. FAIRMAN.

These berries are of some slight agricultural importance. Thus we read in the report of the U. S. Agricultural Department for 1885, p. 613, "To save seed the stalks should be cut when the former are scarlet and ripe, to be stripped by hand or thrashed off on a cloth or floor, then pounded in a wooden mortar with a wooden pestle to break the outer shells. The seeds are then frequently washed to float away the chaff, dried in the sun and air and stored."

Asparagus berries are liable to a disease which may, for brevity's sake, be called black spot.

This is due (*a*) to the growth of fungi in the interior of the berry, (*b*) to growth of fungi on the exterior of the berry.

(*a*) Some asparagus berries which had been gathered in September, 1886, were found, a month or two later, to show black spots in the interior. In the blackened substance of the berry, mycelial threads were frequently found, but fruiting specimens were rare. The black spots were thought to be due to chemical changes in the berry produced by fungi. The fungus which causes this is probably *Penicillium glaucum*. The determination was made according to the figure of this fungus given by Beale.*.

The contents of the berry would seem to furnish a favorable medium for the growth of fungi. Reinsch, in 1870 (according to the National Dispensatory 1879, p. 249), found in the berries considerable grape sugar.

(*b*) External spotting of the berry is due to the growth of fungi on the surface. This was noticed in berries which remained on the stems some time after ripening. The stems are covered at times with a black incrustation which may extend to the berry and involve more or less of its surface. The most common cause of this is the growth of *Cladosporium.*

This brief note will have fully served its purpose if it calls attention to these growths and thus better fruited specimens (than I have as yet found) are secured. As is well known, the most common fungi on decaying vegetable matter are *Macrosporium* and *Cladosporium*. J. B. Ellis (in letter of January 28, 1887), has said:

> It is not improbable that with the proper degree of heat and moisture one or the other of these would make its appearance on the berries in the form of a velutinous or fine hair-like growth of fertile threads bearing the spores or conidia peculiar to one or the other of these genera.

At present nothing farther can with certainty be said.

AN EXPERIMENT IN PREVENTING THE INJURIES OF POTATO ROT (*Phytophthora infestans.*)†

By Clarence M. Weed.

(1) The experiment reported by the author was undertaken to determine what effect the application of a solution of sulphate of copper and lime (known as the Bordeaux mixture) to the foliage of potatoes would have in preventing the injuries of the potato-rot, and was conducted on the grounds of the Ohio Agricultural Experiment Station.

(2) Fifteen feet at the end of each of twenty rows of potatoes were

* Microscope in Medicine, fourth edition, Fig. 7, Plate XXV.

† Summary of a paper read before the Society for the Promotion of Agricultural Science, August 27, 1889.

sprayed with the Bordeaux mixture four times, viz, May 28, June 6, June 29, and July 16. Four varieties were included in the experiment, viz, Early Ohio, Early Oxford, Puritan, and Lee's Favorite.

(3) The season proved favorable for the development of the blight, which appeared in the experimental field about the middle of June, and did serious damage for the next six weeks.

(4) The sprayed vines showed much less injury than their unsprayed companions, remaining green after the others were dead.

(5) The crop was harvested August 22, and the product of 12½ feet of the sprayed part of each row was compared with the product of an equal distance of the unsprayed portion of the same row. The results have been summarized as follows:

(*a*) From the treated portions of four rows of the Early Ohio variety, 536 potatoes, weighing 67 pounds 4 ounces, were obtained, of which 231 were of marketable size and weighed 48 pounds 6 ounces; while from the untreated portions of the same rows 496 potatoes weighing 50 pounds were obtained, 200 of which were marketable, and weighed 34 pounds 4 ounces. There was thus an increase in favor of the treated hills of 17 pounds 4 ounces total product, and 14 pounds 2 ounces marketable product.

(*b*) The treated portions of five rows of Early Oxford potatoes yielded a total of 622 tubers, weighing 87 pounds 1 ounce, of which 321, weighing 70 pounds 4 ounces, were marketable, while the untreated hills of the same rows yielded a total of 707 tubers, weighing 77 pounds 4 ounces, of which 267, weighing 53 pounds 2 ounces, were marketable. There was thus an increase in favor of treated hills of 9 pounds 13 ounces total product, 17 pounds 2 ounces marketable product.

(*c*) The treated portions of six rows of the Puritan variety yielded a total of 727 potatoes, weighing 93 pounds 6 ounces, 327 of which, weighing 70 pounds 4 ounces, were marketable, while the untreated portions of the same rows yielded 810 potatoes, weighing 83 pounds 12 ounces, of which 266, weighing 53 pounds 15 ounces, were of marketable size. There was thus an increase in favor of the treated hills of 9 pounds 10 ounces total, and 16 pounds 5 ounces marketable product.

(*d*) From the sprayed portions of five rows of Lee's Favorite potatoes, 584 tubers, weighing 72 pounds 12 ounces, were obtained, of which 249, weighing 55 pounds 4 ounces, were marketable; while the unsprayed portions of the same rows yielded 658 tubers, weighing 63 pounds 4 ounces, 175 of which were of marketable size, and weighed 38 pounds 12 ounces. Consequently, there was a difference in favor of the sprayed hills of 9 pounds 8 ounces total weight, and 16 pounds 8 ounces marketable weight.

(6) By combining the results given in paragraphs *a*, *b*, *c*, and *d*, we find that the treated portions of the twenty rows yielded a grand total of 2,471 potatoes, weighing 320 pounds 7 ounces, and that 1,128 of these were of marketable size, and weighed 244 pounds 2 ounces; while the

untreated portions of the same rows yielded a grand total of 2,771 potatoes, weighing 274 pounds 4 ounces, of which 948 were of marketable size and weighed 180 pounds 1 ounce. There was consequently a grand total increase in favor of the treated hills of 46 pounds 3 ounces total product, and 64 pounds 1 ounce marketable product.

(7) This 64 pounds 1 ounce increase in marketable product was obtained from 250 feet of row (20 times 12½). This represents an increase of 4.1 ounces to the foot. As there are 14,560 feet of row in an acre of potatoes as ordinarily planted, an increase of 4.1 ounces to the foot amounts to 59,696 ounces, or 3,731 pounds to the acre. Reducing this to bushels by dividing by 60 (the number of pounds to the bushel) we get an increase from the treatment of 62.2 bushels to the acre.

(8) There was in nearly every case a marked difference in the amount of scab on the treated and untreated tubers, the former being much more free from the disease.

CONCLUSIONS.

So far as a single experiment can be relied upon, the results here reported seem to indicate the correctness of the following provisional conclusions:

(1) That a large proportion of the injury done by the potato rot can be prevented by spraying the vines with the Bordeaux mixture.

(2) That this treatment apparently diminishes the amount of scab affecting the tubers.

(3) That by adding London purple to the mixture, the same treatment may be made effective in preventing the injuries of both the rot and Colorado Potato Beetle.

NEW EXSICCATI.

By D. G. Fairchild.

I. PARASITIC FUNGI OF CULTIVATED PLANTS.

The second fasicle of Messrs. Briosi & Cavara's Parasitic Fungi of Cultivated Plants* has been received. The fascicle contains many interesting things, the following of which are of special importance to this country:

Phytophthora infestans, (Mont.) DBy., on *Solanum lycopersicum.*
Plasmopara viticola, B. & C., on *Vitis vinifera.*
Uromyces trifolii, Wint., on *Trifolium pratense.*
Puccinia graminis, Pers., (I), on *Berberis vulgaris.*
Cercospora rosæcola, Pass., on *Rosa, (cult.).*
Coniothyrium diplodiella, (Speg.) Sacc., on *Vitis vinifera.*
Colletotrichium lindemuthianum, (S. & M.) B. & Cav., on *Phaseolus vulgaris.*

* Funghi Parassiti Delle Piante Coltivate od Utili.

It will be seen that the following well-known diseases are represented: The downy mildew of the tomato and grape, the rust of clover and grass, leaf blight of the rose, white-rot of the grape, and anthracnose of the bean. The latter disease, as well as some of the others, have been quite fully illustrated and described in the reports of this Section. It is to be regretted that the descriptive part of this work is Italian; notwithstanding this, however, it seems to us that it would prove a valuable acquisition to the collection of every experiment station.

II. KELLERMAN & SWINGLE'S KANSAS FUNGI.

The second neatly prepared fascicle of the fungi of Kansas has lately appeared. The list of species and host plants is as follows:

ÆCIDIUM CALLIRRHOËS, E. & K., on *Callirrhoë involucrata.*
ÆCIDIUM GROSSULARIÆ, Schum., *Ribes aureum.*
ÆCIDIUM PENTSTEMONIS, Schw., *Pentstemon grandiflorus.*
ÆCIDIUM PUSTULATUM, Curt., *Comandra umbellata.*
ÆCIDIUM TUBERCULATUM, E. & K., *Callirrhoë involucrata.*
CÆOMA NITENS, Schw., *Rubus villosus.*
CERCOSPORA ALTHÆINA, Sacc., *Althæa rosea.*
CERCOSPORA DIANTHERÆ, E. & K., *Dianthera Americana.*
CERCOSPORA JUGLANDIS, Kell. & Sw., *Juglans nigra.*
CERCOSPORA POLYTÆNIÆ, E. & K., *Polytænia Nuttallii.*
CERCOSPORA TUBEROSA, E. & K., *Apios tuberosa.*
DENDRYPHIUM SUBSESSILE, E. & E., *Smilax hispida.*
ENTYLOMA PHYSALIDIS, (Klachbr. & Cke.) Wint., (*a*) *Physalis lanceolata;* (*b*) *Physalis pubescens.*
FUSICLADIUM EFFUSUM, Wint., *Carya amara.*
GLŒOSPORIUM NERVISEQUUM, (Fckl.) Sacc., *Platanus occidentalis.*
PERONOSPORA ANDROSACES, Niessl., *Androsace occidentalis.*
PHYLLOSTICTA IPOMŒÆ, E. & K., *Ipomœa pandurata.*
PUCCINIA NIGRESCENS, Peck., (*a*) *Salvia lanceolata:* (*b*) *Salvia azurea*, var. *grandiflora.*
PUCCINIA SCHEDONNARDI, Kell. & Sw., *Schedonnardus Texanus.*
PUCCINIA SILPHII, Schw., *Silphium integrifolium.*
RAMULARIA URTICÆ, Ces., *Urtica gracilis.*
SEPTORIA TENELLA, Cke. & Ell., *Festuca tenella.*
UROMYCES GRAMINICOLA, Burrill, *Panicum virgatum.*
UROMYCES HYALINUS, Peck., *Sophora sericea.*
UROMYCES POLYGONI, (Pers.) Fckl., (*a*) *Polygonum aviculare;* (*b*) *Polygonum ramosissimum*; leaves (*c*) *Polygonum ramosissimum,* stems.

III. SYDOW'S UREDINEÆ.

The following is a condensed list of the contents of Fascicle III of Sydow's exsiccati, designed to contain only species of the rust fungi, or order *Uredineæ.* Fascicles I and II were issued some time ago; each fascicle contains fifty specimens. The specimens are large and well mounted, and, with the exception of the written labels, the work is altogether a very satisfactory one:

UROMYCES TRIFOLII, (Hedw.) Wint., on *Trifolium hybridum.*
UROMYCES LIMONII, (DC.) Wint., *Armeria vulgaris.*
UROMYCES POLYGONI, (Pers.) Wint., *Polygonum aviculare.*
UROMYCES GERANII, (DC.) Wint., *Geranium molle.*
UROMYCES STRIATUS, Schrœt., *Trifolium arvense.*
UROMYCES ANTHYLLIDIS, (Grev.) Schrœt, *Anthyllis vulneraria.*
UROMYCES ERYTHRONII, (DC.) Wint., *Fritillaria Meleagris.*
UROMYCES ERYTHRONII, (DC.) Wint., ÆCIDIUM, *Erythronium denscanis.*
UROMYCES FICARIÆ, (Schum.) Lév., *Ficaria verna.*
UROMYCES SCILLARUM, (Grev.) Wint., *Muscaria racemosum.*
UROMYCES SCILLARUM, (Grev.) Wint., *Scilla maritima.*
PUCCINIA GALII, (Pers.) Wint., *Galium aparine.*
PUCCINIA CALTHÆ, Link, *Caltha palustris.*
PUCCINIA CIRSII-LANCEOLATI, Schrœt., *Cirsium lanceolatum.*
PUCCINIA LAMPSANÆ, (Schultz) Fckl., *Lampsana communis.*
PUCCINIA CREPIDIS, Schrœt., *Crepis actorum.*
PUCCINIA VIOLÆ, (Schum.) Wint., *Viola hirta.*
PUCCINIA PIMPINELLÆ, (Str.) Wint., *Pimpinella magna.*
PUCCINIA GRAMINIS, Pers., *Triticum repens.*
PUCCINIA CORONATA, Cd., *Glyceria spectabilis.*
PUCCINIA RUBIGO-VERA, (DC.) Wint., *Bromus mollis.*
PUCCINIA RUBIGO-VERA, (DC.) Wint., *Symphitum officinale.*
PUCCINIA POARUM, Niel., *Poa nemoralis.*
PUCCINIA PHALARIDIS, Plowr., *Degraphis arundinacea.*
PUCCINIA SUAVEOLENS, (Pers.) Wint., *Cirsium arvense.*
PUCCINIA HIERACII, (Schum.) Schrœt, *Carlina vulgaris.*
PUCCINIA BULLATA, (Pers.) Wint., *Peucedanum cervaria.*
PUCCINIA FALCARIÆ, (Pers.) Wint., *Falcaria Rivini.*
PUCCINIA FALCARIÆ, (Pers.) Wint., ÆCIDIUM, *Falcaria Rivini.*
PUCCINIA ANEMONES-VIRGINIANÆ, Schw., *Anemone silvatica.*
PUCCINIA TORQUATI, Pass , *Smyrnii olusatrum.*
PHRAGMIDIUM SANGUISORBÆ, (DC.) Schrœt., *Sanguisorba minor.*
PHRAGMIDIUM SUBCORTICIUM, (Schrk.) Wint., *Rosa canina.*
GYMNOSPORANGIUM CLAVARIÆFORME, (Jacq.) Wint., ÆCIDIUM, *Cratægus oxyacantha.*
MELAMPSORA HELIOSCOPIÆ (Pers.) Wint., *Euphorbia esula.*
MELAMPSORA VACCINII, (Alb. & Sch.) Wint., *Vaccinium vitis-idæa.*
MELAMPSORA CIRCÆÆ, (Schum.) Wint., *Circæa lutetiana.*
MELAMPSORA PYROLÆ, (Gmel.) Schrœt., *Pyrola uniflora.*
COLEOSPORIUM SENECIONIS, (Pers.) Wint., ÆCIDIUM, *Pinus austriaca.*
COLEOSPORIUM SONCHI-ARVENSIS, (Pers.) Wint., *Sonchus arvensis.*
COLEOSPORIUM CAMPANULÆ, (Pers.) Wint., *Campanula patula.*
CHRYSOMYXA SEDI, (Alb. & Sch.) Wint., *Sedum palustre.*
CÆOMA EMPETRI, (Pers.) Wint., *Empetrum nigrum.*
CÆOMA LARICIS, (Westd.) Wint., *Larix Europæa.*
ÆCIDIUM AQUILEGIÆ, Pers., *Aquilegia vulgaris.*
ÆCIDIUM PEDICULARIS. Sibosch, *Pedicularis palustris.*
ÆCIDIUM CRESSÆ, DC., *Cressa cretica.*
ÆCIDIUM MESPILI, DC., *Mespilus Germanica.*
ÆCIDIUM MESPILI, DC., *Cratægus grandiflora.*
PUCCINIA HIERACII, (Schum.) Schroth. *Taraxacum officinale.*

A METHOD FOR PRESERVING THE SPORES OF HYMENOMYCETES.*

By Dr. C. O. Harz.

In studying and making a collection of the *Hymenomycetes* the preservation of spore preparations on paper is everywhere enjoined.

Formerly I used a very simple method for colored spores. I allowed them to fall upon any convenient white paper, a process which required from one to two hours up to a half or an entire day, according to the object. After the removal of the fungus I allowed the spores to lie a short time in the air in order to become dry, when I spread a solution of Canada balsam in absolute alcohol, on the back side of the paper, taking care that the spore preparation should not be overflowed by a too copious amount of the fluid. In this manner the preservation or fixing of the spores is accomplished simply and quickly.

I met with difficulties in case of colorless spores, because it is always hard to obtain suitable, well-glazed colored paper whose coloring material is not soluble in alcohol.

Herpell attempted to remove the difficulty by the application of ether, mastix, etc., but I was not always successful in obtaining satisfactory preparations of white spores in this way.

I have successfully tested the following method for two years: Dissolve one part Canada balsam in four parts turpentine oil, warming them gently over a water bath or free flame. Spores of all colors, as well as colorless ones, can be quickly fixed upon any convenient white or colored paper with this solution.

For colored spores I take any smooth, wood-free, white writing paper, of different grades; for white, relatively colorless spores, any convenient glazed paper can be used. Blue and black are specially adapted to the purpose, but yellow, red, green, and other colors of glazed papers also furnish beautiful preparations.

The application of the above solution is very simple; it should be spread thinly on the back side of the paper on which the spores are scattered, with a soft brush, and should not be spread on so thickly as to overflow the spores. In from two to four days the preparations are so far dried out that they can be safely kept between papers. They become quite dry (that is, so that the finger will not rub them off) in four to six weeks.

In some cases this method required some minor corrections.

(1) If the spores have been shed in unusual abundance, it is a good plan to repeat the application once after one or two days, or prepare for this special purpose a solution of two parts Canada balsam in five or six parts of turpentine oil.

(2) If the so-called white spores fall very sparingly on the paper, I

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* Translated from *Botanisches Centralblatt*, 1889, page 78, by E. A. Southworth.

use a solution of one part Canada balsam in from six to eight parts of turpentine oil.

It is perfectly self-evident that any other balsam soluble in turpentine oil, *i. e.*, turpentine, or a resin soluble in it, will answer the same purpose. Any other volatile oil can also be substituted for turpentine oil.

A DISEASE OF WHITE FIR.*

By Dr. Hartig.

A disease of the white fir, which caused very great injuries in the Bavarian woods, was discovered by the author, and shows itself in the dying of the bark of younger or older twigs and branches, often for over a hand's length. As a rule, the dying extends over the entire circumference of the twig, and in consequence the parts of the plants situated above this point die in a few years. More rarely the disease is confined to one side of the twig, and does not progress the second year, but an outgrowth occurs at the edge of the dead place. In the dead bark there develop numerous pycnidia, rarely larger than the head of a pin, which rupture the superimposed cork layer. Within the pycnidia arise numerous small, spindle-shaped gonidia, which germinate readily. Unfortunately, an acigerous fruiting form has not been found after several years of observations and cultures. To be sure *Peziza calycina* almost constantly produced a luxuriant formation of Apothecia in the immediate neighborhood, yet the absolute proof of its connection with the pycnidial form was impossible. Until it can be perfectly known the author has given this fungus the name *Phoma abietina, n. sp.*

NOTES.

By B. T. Galloway.

PREVENTION OF SMUT.

In the first number of The Journal† we gave a brief review of a paper published in the *Journal of the Royal Agricultural Society* of England by J. L. Jensen on "The Propagation and Prevention of Smut in Oats and Barley." The interest shown in this paper has prompted us to publish a description of Mr. Jensen's method of treating the grain, and it is hoped that the suggestions made will enable the experiment stations to test the remedy. Mr. Jensen says:

> We have seen that smut can be prevented by dipping the grain in heated water. * * * The grain to be dipped is placed in a shallow cylindrical basket about 12 inches deep, lined with coarse canvas, and provided with a cover made by stretching the canvas over a ring of such a diameter as will pass inside the mouth of the basket.

* Translated from *Botanisches Centralblatt* No. 3, p. 78, 1889, by E. A. Southworth.

† Page 42.

The canvas should overlap the ring by about an inch all round. An ordinary boiler, such as is found on every farm, is filled with water and heated to the boiling point.

Two vessels of sufficient size are placed near it. These may be designated 1 and 2. Supposing the boiler to contain 35 gallons of boiling water, if 12½ gallons of cold and the same quantity of boiling water be put into each vessel, we shall have 25 gallons of water at 132° F., in both of them. The exact temperature may be readily obtained by adding a little more hot or cold water, as the thermometer shows to be required.

A basket containing three-quarters of a bushel of grain, which must not be more than 8 inches in depth, is now dipped into No. 1 four times; this will take rather more than half a minute, and will reduce the temperature of the water 8 or 9 degrees. It is now to be rapidly dipped five or six times into No. 2, which will take about one minute, and then dip once per minute for three minutes longer, *i. e.*, five minutes altogether in the two vessels This will reduce the temperature of the water in No. 2 from 132° to 129° to 130°. If steeped barley be used the original temperature of the vessels should be 129° to 130°; but with unsteeped grain, for oats, wheat or rye, it does not matter if the original temperature be 133° to 136°.

The seed must now be cooled. This is best done by placing the basket on the top of a third vessel and pouring a couple of buckets of cold water upon the grain in it, taking care that the cold water falls not only upon the center, but round the edges, so that the corn may be uniformly cooled. The basket is now emptied on the floor and the seed spread out in a thin layer, so that it may cool completely. The water used in cooling the grain will have its temperature raised and may be employed in replenishing the boiler. The requisite temperature (132° F.) of vessels Nos. 1 and 2 must be maintained throughout the process by adding from time to time boiling water from the boiler and transferring from them a similar amount back again to the boiler. The temperature must be regulated by a thermometer, which when used must be plunged deeply into the water.

The basket must be completely immersed each time, then lifted quite out of the water so as to allow it to drain for four or five seconds before it is dipped again.

The above process in practice will be found simple and easy enough to perform, although its description is necessarily somewhat complicated.

REVIEWS OF RECENT LITERATURE.

ARTHUR, J. C. *Smut of Wheat and Oats.* Bulletin of the Agricultural Experiment Station of Indiana, No. 28, September, 1889.

While containing little or nothing new, this little bulletin is full of practical matter and will be an invaluable aid to those whose crops are attacked by these diseases.

Most of the bulletin is taken up with *Tilletia fœtens*, or "stinking smut," as Professor Arthur calls it, to distinguish it from black smut.

The fungus is described, and some space is devoted to early opinions as to the origin of smut. In the discussion of the name the author says that the name *Tilletia lævis* should be changed to *T. fœtens*, Rav., since Ravenel was the first to describe and name it.

Under the heading "attack and spread of the disease" the following questions are proposed and answered: "Will the smut spread from field to field while the crop is growing, as rust does? Will there be any danger of introducing it on one's farm by sowing seed wheat from a farm known to be smutted? Can the disease be introduced by the ap-

plication of manure from a farm where it has already gained a foot-hold? When it once gets into the soil will it persist as milk-weed, quack-grass, and Canada thistle do?"

The answer to the first question depends upon when and where the germinating spore enters the wheat plant. It has been pretty well settled that the plant is infected at the time of germination, and the germ tube enters near where the plantlet is attached to the grain. The practical application of this fact is that grains covered with soil can only receive infection from spores that were sown with the seed or already existed in the soil, but that smut will not spread during the growing season from field to field or from plant to plant.

The answer to the second question is a logical sequence of the preceding. If a crop has any portion smutted it is more than probable that the spores of smut will get in contact with the sound wheat kernels. One crushed kernel thoroughly distributed through a bin of seed wheat may result in many dollars' loss when the crop is harvested. Other sources of contamination are also given, viz: The thrasher having previously been used for smutted wheat; being stored in a bin or passed through a fanning-mill or seeder not properly cleansed after being used for smutted wheat; by using sacks that have not been disinfected.

The third question is answered in the affirmative. It has been shown that corn smut can pass through animals and retain its germinating power, and the same is likely true of wheat smut.

Spores retain their power of germination when dry for two or three or even more years, but in the field we may safely assume that two years will eliminate every trace of it.

Natural checks to its increase are ably discussed; they are, mainly, probability that the spores may not be near enough to the germ end of the kernel, insufficient moisture, and resistant varieties.

The nature of the injury is of a more comprehensive nature than is generally supposed. A definite percentage of the crop is actually lost. An extra amount of cleaning and screening is required for what is good. The wheat is unfit for seed until disinfected. The smut gives the flour a dark color and disagreeable smell. The straw and screenings are liable to spread the disease when converted into manure.

Under the heading "remedies and precautions" the author says that the prevention of smut costs not a fraction of the trouble or expense that is necessary in removing the Colorado beetle from potato-vines. The method of disinfection preferred is a soaking of the seed in a solution of blue vitriol, and several methods for doing it are given in full. The methods of prevention are very emphatically summed up as follows: "Clean seed upon a clean field will result in a clean crop."

Very little space is given to the black smut; its general appearance, habits, and botanical characters are described. The same method of treatment as that described for stinking smut is recommended for this

except that, on account of the hulls, oats and barley should be soaked longer.—E. A. SOUTHWORTH.

BOLLEY, HENRY L. *The Heterœcismal Pucciniæ.* American Monthly Microscopical Journal, Vol. X, 1889.

The author of this paper starts with a general account of the biology and classification of the *Uredineæ*, gives a short description of the internal arrangement of the order, as well as its position among the fungi, and a definition of *heterœcism*, ascribing as a cause "inherent wants of the parasite not to be satisfied by one of its hosts alone," rather than to any difficulty which the promycelia might find to an entrance into the host tissue. Taking up the mycelium, a short description is given, with a belief that there are no true haustoria, but that young mycelial threads, penetrating the cell walls, give the misleading appearance. The article treats of æcidia and spermogonia at some length, without, however, attempting to clear up the mystery of their designed use. Under the account of the teleutospore, a doubt is expressed in regard to the existence of the so-called germ-pores. The author finds in the process of germination, instead of the passage of a germ-tube through a previously formed canal, a gradual erosion of the endospore from within. In regard to the question of sexual or non-sexual reproduction in the order, the work of Dr. George Massee is criticised, claim being made that the stroma, which bears ultimately the æcidial spores, does not consist, as figured by the latter, of a stalked body, but of a mass of interlaced hyphæ—branches and extensions of ordinary hyphæ. In the cases studied by Mr. Bolley *Æ. berberidis* and *Æ. hepaticarum*, the basidia arise as bud-like branches from individual hyphæ without any characteristics of a sexual process, and the author coincides with H. Marshall Ward in the thought that this process has disappeared, not being longer needed by the fungus.—D. G. FAIRCHILD.

FARLOW, W. G. *Notes on Fungi.* Botanical Gazette, August, 1889.

In the last number of the *Botanical Gazette* Dr. Farlow gives an account of a *Cystopus* causing peculiar swellings on the stems of *Ipomœa pandurata*, sent him by Prof. L. H. Pammel from Missouri. It appears from the note that the form of *Cystopus* upon the *Convolvulaceæ* of the United States has hitherto been found wanting in oospores, raising the question whether or not it should be united under *C. cubicus* (Strauss), Lév., which inhabits the *Compositæ.* The specimens sent by Professor Pammel seem to have abounded in peculiar oospores. The oogonia also differed from those of others of the same genus, in having their walls raised in blunt papillæ or short flexuous ridges over the whole surface. Differing as it does in oogonia and oospores from *C. cubicus*, the author thinks it clearly can not be placed under it. The name *C. convolvulacearum*, Otth, used by Kellerman and Ellis, is considered, after correspondence with Dr. Fischer, of Berne, as only a manuscript name used by

Otth and first published by Zalewski, in 1883; which latter authority for *C. convolvulacearum* is consequently preferred, but the author considers the Schweinitzian name *Æcidium ipomœæ-panduranæ*, given in 1822, as the first name applied to the form on *Convolvulaceæ* in North America.

Mention is made in the same paper of a very interesting *Peronospora*, found to agree with *P. Cubensis*, B. & C., which has been found independently in Cuba, Japan, and New Jersey, in which latter place it has attacked most vigorously the cucumber vines. It is especially interesting biologically as an exception to the general rule that only small conidial spores produce zoospores.—D. G. FAIRCHILD.

CAVARA, DR. F. *Materiaux de Mycologie Lombarde*, Revue Mycologique, October, 1889.

The author gives a list of the fungi of Lombardy, the following orders being represented: *Myxomycetes*, 4; *Zygomycetes*, 4; *Oomycetes*, 12; *Ustilagineæ*, 4; *Uredineæ*, 11; *Discomycetes*, 12; *Pyrenomycetes*, 33; *Hyphomycetes*, 44; *Sphæropsideæ*, 41; *Leptostromaceæ*, 4; *Melanconeæ*, 13; Imperfect forms, 3. Fifteen of the species are new and are fully described and illustrated by two plates. There are also many interesting notes on some of the injurious species.—B. T. GALLOWAY.

FULTON, T. WEMYSS. *The Dispersion of the Spores of Fungi by the Agency of Insects, with Special Reference to the Phalloidei.* Annals of Botany, May, 1889, p. 207.

This interesting article may be divided into two rather distinct parts, the first comprising the results of Mr. Fulton's experiments with *Phallus impudicus*, and the second containing data gathered from different sources to prove that the adaptation of fungi for the visitation of insects is quite general among certain families.

After a description of the structure and development of the common Stinkhorn (*Phallus impudicus*), attention is drawn to the fact, noticed previous to 1575, that the liquefied hymenium, or stinking slime, of this species has great attractions for insects, especially two species of fly, *Musca vomitoria* and *Musca Cæsar.* To settle two important questions suggested by these insects feeding upon the slime filled with the ripe spores of the fungus, the effect of the slime upon the fly and the effect of the fly upon the spores, the author conducted two series of experiments. The first series, involving the first question, proved, as might be expected, that the slime has no effect upon the fly either before or after death. The second series, consisting in an attempt to produce the fungus from spores which had traversed the digestive organs of the fly, was measurably successful, although slightly incomplete, from the fact that only two out of four trials produced the characteristic mycelium, and of these, the one given an opportunity to develop its compound sporophore failed to do it. The author does not mention in his account of the experiment any attempt to free the excrement from

spores which might have been shaken from the feet and proboscides of the flies and have not traversed the digestive canal. From the connection it might naturally be supposed that no attempts were made.

Turning from a determination of the fact experimentally, the author, first making the statement that "it seems very probable that most all of those fungi whose spores are ultimately contained in a slimy or liquid substance of dark color, especially if of a fetid odor, and which is freely accessible, will be found to have their spores largely transported by the agency of insects," takes up the British *Coprini*, pointing out the superficial resemblance of their sporophores to the compound flowers of certain *Compositæ* and calling attention to the fact, in connection, that flies are alike the principal visitors of the flower and the fungus.

The *Phalloidei*, which to the author present the most striking adaptations to insect visitations, occupy considerable space in the paper, short tabulated descriptions—color, odor, habitat, and dimensions—of 59 species being contained. The summary from these descriptive tables shows that the color of the receptacle during the deliquescence of the hymenium in more than half of the species is some tint of red, and in the remainder, white; these colors occurring in 91 per cent. of the 59 species. Table IV gives the colors of more than a thousand species of fungi, other than *Phalloidei*, and reveals the fact that while 91.5 per cent. of the latter are either red or white, only 20.1 per cent. of other fungi are so colored, the great majority being brown, slate, or black—colors scarcely represented in the former group. The bearing of these data upon the author's inference that the brilliant tints of the *Phalloidei* have been developed to render them conspicuous is quite pointed, and when taken in connection with his last table—which is a comparison of 4,197 species of flowers with 59 *Phalloidei* and 1,288 other fungi —becomes doubly so. Table V shows that while only 73 per cent. of flowers and 24.7 per cent. of other fungi are white, red, or yellow—colors found by experiment to be the most conspicuous in wooded localities where fleshy fungi grow—96.6 per cent. of the *Phalloidei* are so colored.

In regard to the odor, determined in the case of 25 species, 76 per cent. were fetid. When this proportion is compared with that of odorous to inodorous flowers—9.9 per cent. determined from 4,189 species—and taken in connection with the numerous facts just mentioned, the author is warranted in concluding that "in the *Phalloidei* it can scarcely be doubted that we have a group of fungi which have undergone great modifications so as to become adapted for the dispersion of their spores by the agency of insects."—D. G. FAIRCHILD.

GIRARD, ALFRED. *Entomogenous Fungi.* Bulletin Scientifique de la France et de la Belgique. January–April, 1889.

This number contains three valuable and practical articles on Entomogenous fungi. The first, entitled (*Sorosporella agrotidis*, nov. gen.

et sp.) "A New Parasite of the Caterpillar of the Sugar Beet," is translated by A. Girard from a German article by N. Sorokin.*

The "gray worm" (Caterpillar of *Agrotis segetum*) is, he says, very troublesome in the southern provinces of Russia, and, judging from previous experiences with the wheat aphis, he thinks it possible to fight the enemy effectually by means of entomogenous fungi; but it is of the greatest importance that each farmer should know beforehand the amount of fungous powder (powder containing the spores of the fungus employed) required to infect a given area. To this end Professor Cienkowski has calculated the number of spores contained in a square millimeter and then in a cubic foot. Professor de la Rue has also estimated how much pure spore powder it requires to cover a given area with a layer of spores .008 of a millimeter thick (twice the thickness of a spore). This calculation is supplemented by Professor Saikewitsch, who has determined that the interstices of a given amount of earth will take up one half its volume in pure spores, so that if impure powder is used twice as much will be required as of the pure.

The author placed several diseased "gray worms" in a box, where they soon died, and on examining them he decided that they were infested by a hitherto undescribed fungus to which he gave the name *Sorosporella agrotidis*. It is with this fungus that he hopes to be able to conquer the *Agrotis*.

The second article is a review of the preceding by the editor and translator, Alfred Girard.

He has compared Sorokin's description with Krassilstschik's description of *Tarichium uvella*, also a parasite of *Agrotis segetum* found in Southern Russia, and considers that the two fungi are probably identical. The name, he says, should be *Sorosporella uvella*, as the *T. uvella* of *Krassilstschik* can not be considered an *Entomophthora*, but is more closely related to the genus *Massospora*, Pk.

Northern France is, he says, as subject to attacks from the "gray worm" as Southern Russia, and the most chimerical remedies have been used to fight the scourge. In France he has often met a parasite of the "gray worm," *Entomophthora megasperma*, Cohn., which was of great aid in stopping the ravages of the *Agrotis* in 1867.

Unfortunately, however, only the *Tarichium* form—that is the resting spores—is to be found either in France or Germany, and all attempts at infection with it have failed. These resting spores may, however, develop and produce conidia in certain culture media. The best one for *Entomophthora calliphoræ* being the excrements of a batrachian.

From an incomplete experiment of Krassilstschik it would seem that under certain conditions *E. megasperma* develops the conidial form on the caterpillars of *Agrotis*, and the author suggests that this result might be regularly obtained by keeping the "gray worms" under glass, just

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* Published in the *Centralblatt für Bakteriologie und Parasitenkunde*, 1888, IV. Bd. n. 21, pp. 644–647.

as the parthenogenetic generations of aphides can be indefinitely multiplied by keeping them in a continual summer environment. These suggestions are given to indicate the proper line of experiments to be followed out in fixing upon some plan for exterminating the "gray worm" in countries where it is injurious; and the paper closes with the remark that it is time to start in France an entomological department like the one now in operation in the United States.

The third article is another review by A. Girard, this time of a Russian paper, by Krassilstschik, bearing the Latin title: "*De insectorum morbis qui fungis parasitis efficiuntur.*" Much of the article consists of a critical analysis of Krassilstschik's work, and those parts will be omitted. In this review I shall only touch upon the points which have a bearing on the subject in question, and what follows will mainly consist of very free translations of portions of Girard's paper.

On the practical side of the question Krassilstschik seems to have obtained very remarkable results. Artificial cultures of the conidial form (*Isaria*) of certain *Pyrenomycetes* appear to have been made as easily as those of yeast or *Schizomycetes*. This success is very encouraging, and should impel us to take up new experiments on the *Entomophthoreæ*, which, up to the present, have resisted every attempt to cultivate them in lifeless media. Thaxter's researches have shown that some *Entomophthoreæ* are less exclusive in their choice of a host than was formerly supposed.

If Thaxter's experiments are verified, can not we cultivate *E. grylli* on the caterpillars of *Arctia*, which are so common and easy to raise, and use the spores so produced to infect the *Acrideæ* and arrest their ravages?

The observation of an *Entomophthoreæ* parasite on *Cecidomya destructor*, Say, is of very great interest. *Cecidomya destructor* is one of the most injurious insects, and it would be very important to be able to effectually combat it Krassilstschik has met this fungus both in the *Tarichium* and conidial state. He has also discovered an *Entomophthora* on the caterpillar of the nocturnal *Agrotis segetum*, which, in the vicinity of Odessa, especially attacks the rye. This is a very interesting fact, he observes, for Cohn has found a *Tarichium* on the same caterpillar without ever having met any conidia. In northern France I have met only the *Tarichium* form of the *Entomophthora* of the *Agrotis*, but a few mummified caterpillars which I placed in a moist chamber at a somewhat elevated temperature became covered with a whitish down analogous to the conidial stage of the *Entomophthoreæ*; unfortunately the observation was interrupted and I was unable to demonstrate the presence of conidia.

The discovery of *Botrytis Bassiana*, Bals. on two new hosts (*Musca domestica* and *Athalia berberidis?*) made by Kowalevsky in the neighborhood of Odessa deserves special note. We know that Metschnikoff has already observed the white muscardine on *Anisoplia*. Krassilstschik

has found the same parasite upon *Cleonus punctiventris*, Germ. The insects that are so formidable to beet growers of southern Russia may then be effectually combatted by three fungi; the green muscardine (*Isaria destructor*, Metsch.), the red muscardine (*Sorosporella uvella*, Krassil.), and the white muscardine (*Botrytis Bassiana*, Bals.).

Vendhalm and Krassilstschik have also discovered a new species of *Isaria* upon an undetermined *Lixus* (larva and nymph), an *Isaria* that can undoubtedly be utilized in ridding ourselves of the different Curculios that attack the *Carduaceæ*.

But the fungus which Krassilstschik has most thoroughly studied is one which he has met on the eggs of the migratory locust (*Pachytylus migratorius*). This is a conidial form which Krassilstschik believes belongs to the *Isaria* of *Cordyceps ophioglossoïdes*, Ehr. & Tul.; this is also, it seems, the opinion of Professors Cienkowsky and Reinhardt, who have seen his preparations of the fungus.

If the *Isaria* on locust eggs is really *Isaria ophioglossoïdes* we find ourselves in the presence of a very curious fact.

The locust eggs evidently do not supply the fungus with sufficient nutriment for the development of the highest order of reproductive organs—the asci. But how does it happen that in certain localities *Cordyceps ophioglossoïdes* abandons the eggs of the *Acrideæ* to develop further on *Elaphomyces?*

The *Elaphomyces* are subject to invasions of numerous parasites and in particular of the dipterous larvæ of the genus *Helomyza*. Now the *Diptera* of this group are in turn often infested by entomogenous *Sphæriaceæ*. It seems to me very probable that the *Cordyceps* parasitic on *Elaphomyces* lived at first in the *Isaria* stage upon the larvæ of the *Diptera* which infested them, and from there extended their mycelium to *Elaphomyces* itself, where, thanks to more abundant nutriment, they could produce their asci. It is even possible that this might have occurred during the phylogenetic evolution, and that at present *Torrubia ophioglossoïdes* and *capitata* attack *Elaphomyces* directly.

The article concludes with the following direct translation (into French) from Krassilstschik's paper.

Although De Bary is lately inclined to accept Tulasne's view that *Isaria* is only the conidial form of *Cordyceps*, and considers it very probable that *Isaria farinosa* belongs to the cycle of development of *Cordyceps militaris*, it is necessary to observe that the genus *Isaria* comprehends an enormous number of forms; and since the union of this genus with that of *Cordyceps* is probable only for one species, it is useful for the time to retain the genus *Isaria* and to designate each form by a special name.

As to *Botrytis Bassiana*, De Bary as well as Brefeld formerly considered it as the conidial form of a Pyrenomycete (*Melanospora parasitica*); he appears, however, to have given up the idea after numerous cultures and experiments.

The genus *Stilbum* has but a few victims and one representative among muscardine fungi. This one is *Stilbum Buqueti.* Although this fungus is not perfectly well known, and for that reason we can scarcely expect to know whether it passes all its stages on insects, still, according to Buquet, the fungus develops only on dead insects; and, judging from Robin's descriptions and excellent drawings, we must accept his view that *Stilbum* develops while the insect is living, completing its development after the death of the same; in a word, it behaves like a true muscardine.

In regard to *Tarichium* I have already said that this genus ought to follow *Entomophthora.* The difficulty of making artificial cultures of *Tarichium* and the impossibility of the artificial infection of insects with the spores of this fungus render the study of this group of organisms extremely interesting.

In the fungi noted on our list as accidentally developing on insects and possessing an entomogenous function, is one representative of the genus *Cladosporium.* Although the majority of the species of this genus are known as parasitic on plants, and *Cladosporium* does not exhibit parasitic qualities in the animal kingdom, it is necessary to call attention to the one case of this kind supported by a mycologist as experienced and learned as Professor Salensky, of Kazan. It may seem a little strange at first thought that a parasite as useful as *Cladosporium parasitium*, Sorok., which lives upon *Polyphylla fullo*, can be in a given case understood as only an accidentally saprophytic fungus.

It is useless to speak of *Penicillium* as entomogenous. *Penicillium glaucum*, which, in the opinion of Lohde, may be parasitic on a butterfly, *Bryophila raptricula*, can in no sense be reckoned among the entomogenous fungi; and if *Penicillium glaucum* does develop on dead chrysalides that are really attacked with muscardine it is simply as an after effect and a saprophyte. There is no doubt that the chrysalides of which Lohde speaks were already affected by another parasitic fungus before *Penicillium glaucum* developed.

The yeast fungi have nothing in common with the muscardines, and if formerly it was possible to believe, as Bail did, that the house-fly was killed by a yeast fungus, we know now, after the excellent researches of Brefeld, that the supposed yeast is only an *Entomophthora* in a certain stage of development. * * *

It is still necessary to mention the genus *Metarhizium* of which there are also certain representatives on our list. This new genus was established by Prof. N. Sorokin for the green muscardine, discovered by Metschnikoff upon the larvæ of *Anisoplia austriaca*, and called by him *Entomophthora anisopliæ.* As the characteristics of this fungus do not perfectly agree with those of *Entomophthora*, Professor Sorokin proposed to call it *Metarhizium.* But as Metschnikoff has since given the green muscardine the name of *Isaria destructor*, and as my long observations upon this fungus and a large number of pure cultures have proved to

me that the fungus of the green muscardine approaches in every respect the genus *Isaria*, the name *Metarhizium* became useless, the more so because the other representatives of this genus were imperfectly established. The fungus of the green muscardine has, besides, the typical aspect of an arborescent *Isaria* upon the larvæ of *Cleonus punctiventris* when placed in moist sand. In artificial cultures *Isaria destructor* is known besides under the form *Coremium*.

The ingenious names which Lebert has given to different forms of entomogenous fungi, such as *Verticillium*, *Polistophthora*, *Acanthomyces*, etc., by no means represent new forms but are only synonyms for *Cordyceps* and *Isaria*.

It remains to be seen in how many cases muscardine parasites of insects can develop under artificial conditions. It is said that experiments were made upon twenty-four different species of insects and always gave favorable results. Besides these, there were four other cases of contagion, which, although observed under artificial conditions (not in open air), did not arise from spores sown intentionally.

In these latter cases the parasite developed upon insects inclosed in bottles or boxes. It is interesting to note that in almost every case artificial infections are due to fungi of the genera *Isaria* and *Botrytis*; that is to say, to fungi whose artificial cultures succeed marvelously.

On the contrary, infections with the genera *Cordyceps* and *Entomophthora* are more restricted in number. Up to the present time artificial cultures of these genera have not succeeded at all. For the genus *Cordyceps* we have but one experiment by De Bary and for *Entomophthora* three experiments by Brefeld. No experiments have been attempted with *Stilbum*, but judging from the structure of the fungus, so like that of *Isaria*, it appears probable that artificial cultures and infections will succeed as well with it as with *Isaria*. With *Tarichium* all attempts of contagion have failed completely, and consequently artificial culture is shown to be impossible.

If later researches confirm the cycle of development of *Tarichium uvella*, and if the complete development of other representatives of this genus can be obtained in artificial cultures, it will then be possible to attempt infection with spores artificially produced. As has been indicated, the ordinary spores of *Tarichium* will never produce contagion when placed in contact with the bodies of insects.—EFFIE A. SOUTHWORTH.

HARTIG, Dr. ROBERT. *Lehrbuch der Baumkrankheiten.* Zweite verbesserte und vermehrte Auflage. Mit 137 Text-Abbildungen und einer Tafel in Farbendruck. Berlin. Verlag von Julius Springer, 1889. 8vo, cloth, pp. 291.

The second edition of Dr. Hartig's *Lehrbuch* embodies much interesting information in a convenient form and can not fail to meet with the same favorable reception as the first edition published in 1882.

Only one lithographic table has been introduced and an effort has been made to simplify the text as much as possible. What is here omitted the specialist will find in original papers, which in any event he would desire to consult, and the general reader will welcome the clear style and freedom from technical description. The individuality of the author is visible everywhere. He has copied no one, not even in the matter of wood-cuts and the result is an exceedingly interesting and useful book.

The introduction discusses briefly:

(1) The development of the doctrine of plant diseases (commencing with Schreger, 1795); (2) Causes of disease; (3) Methods of investigation.

The body of the work is divided into four sections: (1) Injuries by plants; (2) wounds, *i. e.*, mechanical injuries; (3) sickenings through influence of the soil; (4) sickenings through atmospheric influences. The first section contains 175 pages, the greater part of which is devoted to parasitic fungi. The treatment of this subject is somewhat broader than the title of the book would indicate, brief mention being made of diseases attacking grains, vegetables, and other herbaceous plants.

The author is most at home upon the wood-infesting and tree-destroying species, to which he has devoted many years of profound and painstaking inquiry. The following *Hymenomycetes* are described as destructive to living wood: *Trametes radiciperda*, *T. pini*; *Polyporus fulvus*, *P. borealis*, *P. vaporarius*, *P. mollis*, *P. sulphureus*, *P. igniarius*, *P. dryadeus*; *Hydnum diversidens*; *Telephora Perdix*; *Stereum hirsutum*, and *Agaricus melleus*. Mention is also made of *Polyporus fomentarius*, *P. betulinus*, *P. lævigatus*, and *P. Schweinitzii*, and the author believes that numerous other *Polypori* not yet critically investigated live as parasites in the wood of trees. *Dædalea quercina* and *Fistulina hepatica* are also probably parasitic, at least the former.

The destruction of timber receives considerable attention. There is a "dry rot" due to various fungi, the spores of which often find their way into cracks on the surface of logs while lying in the forest. These spores germinate the following summer while the logs are at the mill, if the heat and moisture are sufficient. The first symptom is a red-striping of the timber. The loss from this cause in the Bavarian forest is stated to be 33 per cent. of the entire product. The most vexatious timber-destroyer appears, however, to be the house fungus *Merulius lacrymans*. This attacks and destroys low lying or damp portions of buildings, and is peculiarly a plant associated with men, although it sometimes occurs in the forest. The extremely minute spores, about four million of which could be packed in the space of a cubic millimeter, germinate only in presence of some alkali, and this is thought to be the explanation of the fact that the fungus is most likely to appear in parts of buildings wet by urine, ashes, etc. When fresh, this fungus

has a very agreeable smell and a fine taste, afterward somewhat astringent. The mycelium excretes large quantities of water and keeps dwelling rooms excessively damp. In decay, the sporophores produce a very characteristic disagreeable odor, which is undoubtedly prejudicial to health. Infection may take place either through mycelium or spores. The latter are often carried from place to place on clothing, tools, etc., which have been used by workmen, especially carpenters, in repairing decayed buildings.

The book seems to have been very carefully prepared, but some omissions are noteworthy, and occasionally one meets a questionable statement.

Under *Gymnosporangium* four species are mentioned—*G. conicum* (*juniperinum*), *clavariæforme*, *Sabinæ* (*fuscum*), and *tremelloides*. The author thinks a further investigation of the forms thus far known and described is desirable, as the results of some experiments instituted by him do not agree with those commonly accepted. No mention is made of the labors of Dr. Farlow or of Dr. Thaxter.

Under bacteria Dr. Hartig urges the commonly accepted view that the acid reaction of most plants is unfavorable to their growth and development, and evidently thinks they play a very unimportant rôle in the production of plant diseases. They have been found as parasites, he says, only in thin-walled, soft parenchymatous tissue, such as bulbs and tubers, and here are often preceded by fungi. Even in Waacker's hyacinth disease (the yellow, slimy bacteriosis) "the bacteria do not attack entirely sound, well-ripened bulbs under normal conditions," but only those that have been wounded or previously attacked by fungi, especially by a hyphomycetous fungus, which is almost always associated with this bacteriosis. In damp places the bacteria enter the wounds and cause the rot. The following paragraph on pear blight will hardly pass muster, and was certainly not to be expected in a handbook published in 1889. All the recent American publications on this subject, especially the papers by Dr. Arthur, appear to have escaped the author's attention.

Recently a disease of pear and apple trees, called blight, has been described by J. Burrill in Urbana, Ill., the cause of which this investigator ascribes to the invasion of a bacterium. The disease appears to bear a resemblance to the tree canker (*Baumkrebs*) caused by *Nectria ditissima*, and since in this fungus small bacteria-like gonidia are produced in great numbers in the bark, it becomes necessary to inquire first of all whether this disease has not been wrongly ascribed to a schizomycete.

Mention is made of fifteen species of *Exoascus*, all of which produce characteristic hypertrophies. Seven of these species also cause *hexenbesen* or witchbrooms, and these peculiar growths are also induced by various *Uredineæ*, notably by the æcidium (*Peridermium pini*) of *Coleosporium senecionis*, and by *Æcidium* (*Peridermium*) *elatinum*.

The black-knot of the plum and cherry, *Plowrightia morbosa*, is said to occur only in North America, but the author thinks it may be in-

troduced into Europe at any time. This is quite likely and the wonder is that it should not have occurred before, owing to the fact that it is found on all our species of *Prunus* and is very destructive in many parts of the eastern United States.

The volume ends with a brief index, preceded by a convenient synopsis of diseases (215 in number). This is arranged alphabetically according to hosts, and under each host according to organs, so that the reader who knows the name of the host and of the part attacked can quickly refer to the description of the disease in the body of the text.—ERWIN F. SMITH.

KELLERMAN & SWINGLE. *Branch Knot of the Hackberry.* Report of Botanical Department, in First Annual Report of the Kansas Experiment Station, 1888.

This article is especially interesting to lovers of fungi from the fact that it relates to the peculiar double effect of plant parasite and insect irritation upon the same portion of host tissue. The infecting fungus *Sphærotheca phytoptophila*, Kell. & Sw., appears to be a new and quite distinct species, choosing as its home the peculiar formations caused by a *Phytoptus* or gall-mite, which remains as yet undescribed. Many small branches of the hackberry (*Celtis occidentalis*, L.) have upon them knots and clusters of small abnormal twigs, which were supposed to be wholly due to the attacks of insects until the authors of this paper in March, 1888, discovered the mycelium and fruiting bodies of this new powdery mildew growing upon the buds and stems of the diseased portions. Up to this time only two species of the *Erysipheæ* had been found growing upon the *Celtis*, both of which belong to the genus *Uncinula*, and only one as an inhabitant of Phytoptus galls—a *Microsphæra*. A portion of the article is taken up with a description of the curious distortions caused by the gall-mite and mildew combined, two photo-lithographs of different styles or types being added. Following this is a short account of the general characters of the *Erysipheæ* and a very full and carefully prepared description of the species in question. The presence of *Cicinnobolus Cesatii*, DBy., the common parasite of the powdery mildews, is noted, and shares with the gall-mite a short description. As remedies for this complex disease, which disfigures and enfeebles the hackberry trees—used quite frequently for ornamentation in the West—the authors suggest the use of sulphur and its compounds along with that most effective of preventive measures, a removal and destruction of the diseased portions during the winter season.

Whether or not the fungus and gall-mite are independent of each other the paper does not attempt to decide, but leaves the matter for further experimentation, throwing out the suggestion that it may be possible for the mite to form galls without the fungus, but not for the fungus to live separated from the gall.—D. G. FAIRCHILD.

SCRIBNER, F. L. *Diseases of the Irish Potato.* Bulletin of the Agricultural Experiment Station of the University of Tennessee, April, 1889.

In this paper the author discusses the potato rot, caused by the fungus *Phytophthora infestans*, and a new disease, due to a nematode or thread-worm. After giving a detailed account of the habits of the former, the paper concludes with a chapter on treatment, which is briefly summed up as follows:

Select for planting a light, sandy loam, or a soil which is well drained; plant only perfectly sound or disinfected seed; spray the tops with the Bordeaux mixture* or some preparation containing sulphate of copper; store in a cool *dry* place, and keep dry.

The new disease was discovered among the potatoes obtained from the University farm, and is described as causing the tuber to wither, then dry up, and become hard. The skin is only partially discolored, but the surface is covered with small pimples, each surrounded by a depression. Sections through a diseased tuber revealed the fact that the flesh was apparently sound, but slightly wilted. The only discoloration of the flesh was immediately under the pimples; here the tissues were brown. Under the microscope it was seen that the brown areas were filled with numerous little worms of various sizes and in all stages of development.

"These little worms," says the author, "were at once recognized as nematodes or thread-worms, and were evidently the cause of the disease."

"How did these worms get into the potatoes? Probably from the soil in which they were grown, for it is known that many of the parasitic nematodes spend a certain period of their existence under ground. It is very likely that they were first introduced into the University farm through planting infected seed. The potatoes planted were being saved for seed, and were these to be planted they would certainly carry the worms to the new crop and thus perpetuate the disease."

Owing to the limited knowledge of the life history of the nematode, the author says it is impossible to indicate any definite course of treatment. —B. T. GALLOWAY.

SHIPLEY, A. E., Cambridge, England. On *Macrosporium parasiticum.* Annals of Botany, May, 1888.

This is a note probably called forth by Kingo Miyabe's paper which was reviewed in the last number of THE JOURNAL.

In 1887 the author was sent to the Bermuda Islands to study an onion disease prevalent among the onion plantations of the colony and supposed to be due to insect attacks. He found a fungous disease having two stages, the first caused by *Peronospora Schleideniana*, the second by *Macrosporium parasiticum.*

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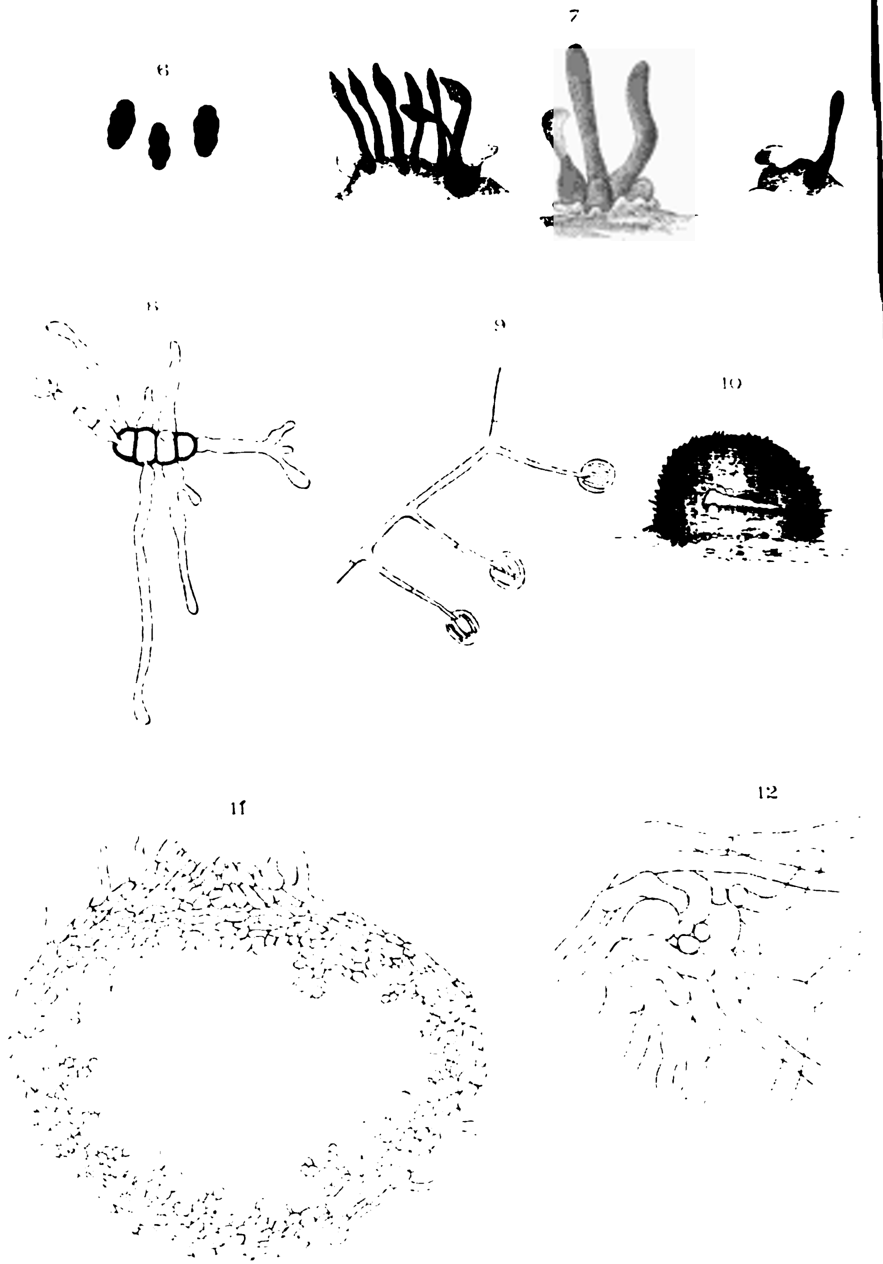
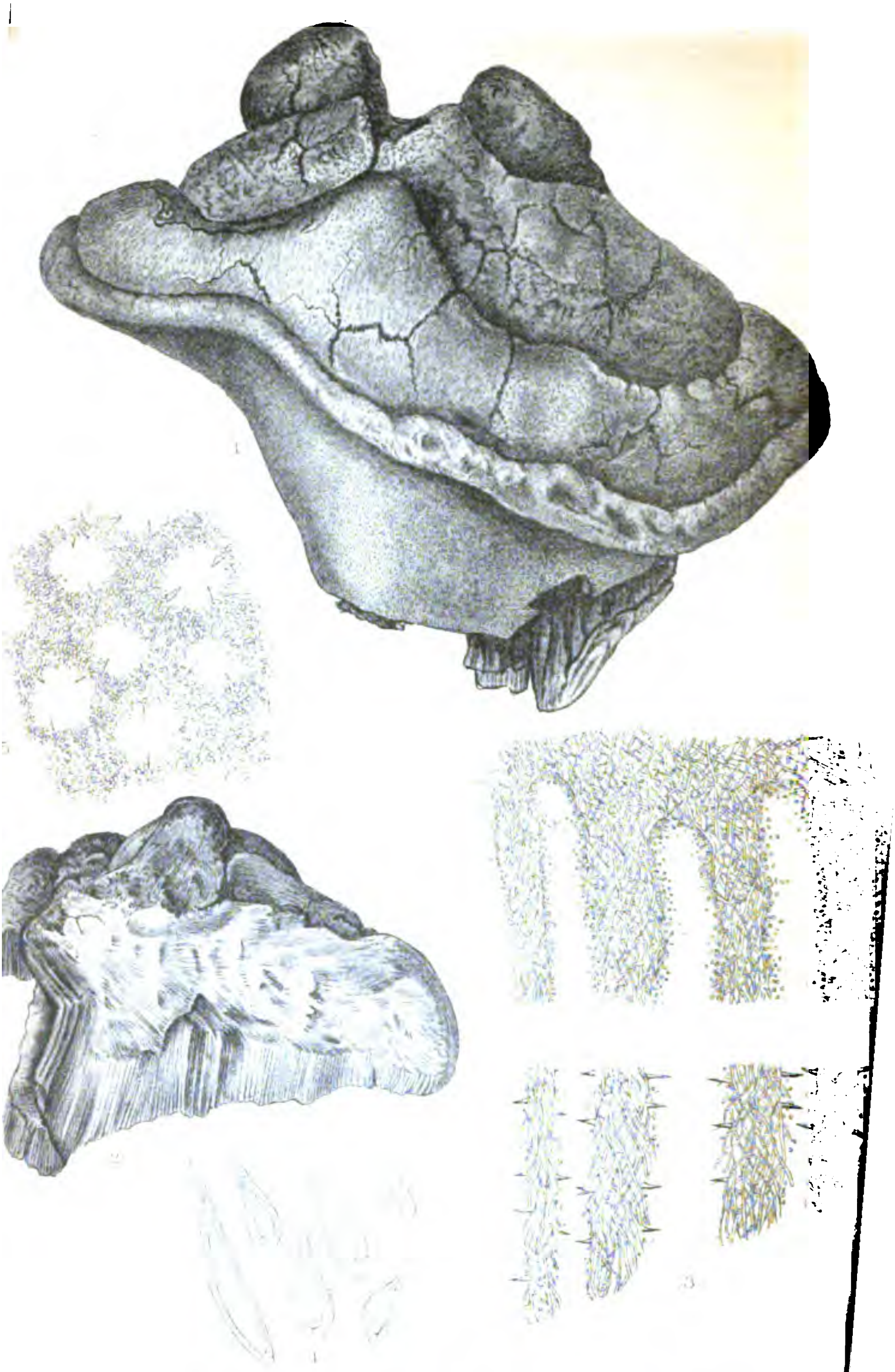
* See Mr. Weed's paper on page 158.



VON TAVEL ON DEVELOPMENT OF THE PYRENOMYCETES.

FENESTELLA PLATANI.



ELLIS AND GALLOWAY ON A NEW MUCRONOPORUS.

MUCRONOPORUS EVERHARTII.

A. Hoen & Co. Lith. Baltimore

The mycelium of the *Macrosporium* ramifies through and not between the cells of the host, and the fertile hyphæ bore their way to the surface through the outer cell wall of the epidermis, their apices apparently exerting some solvent action on cellulose. He has not observed them projecting from the stomata as Mr. Miyabe did.

Mr. Shipley further takes issue with Mr. Miyabe in regard to the parasitism of the fungus. He has never seen a plant suffering from *Macrosporium* that had not previously been attacked by *Peronospora*. In other respects, except the development of the perithecia, which he did not observe, his observations confirm those of Mr. Miyabe.—EFFIE A. SOUTHWORTH.

UNDERWOOD & COOK. *Generic Synopses of the Basidiomycetes and Myxomycetes.*

This is the title of a work designed "as an aid to instructors as well as a guide to students wishing to pursue the study of fungi alone." Accompanying this work are one hundred neatly labeled specimens of fungi illustrating the more important groups. These, together with the synopses, which consist of twenty-one pages bound in a neat octavo volume, sell for $6.00.—B. T. GALLOWAY.

DESCRIPTION OF PLATES.

PLATE XI (*After von Tavel*).

FIG. 6. Ascospores. × 300.
7. External appearance of the stroma with perithecia and pycnidia. Slightly magnified.
8. Germinating ascospore, three days after being sown in water. × 600.
9. Hypha, with gonidiophores of *Acrostalagmus* in moist air. × 300.
10. Young pycnidium. The outer layer has become differentiated and the formation of the cavity has begun. × 80.
11. Vertical section through a pycnidium produced on a leaf. × 214.
12. Early stage of a pycnidium, from a cross-section through an infected leaf. × 700.

PLATE XII.

FIG. 1. *Mucronoporus Everhartii*, natural size.
2. A piece of the same showing length of pores in vertical section.
3. Longitudinal section of pores, with central portion cut out.
4. Spines enlarged.
5. Cross-section of pores.

ERRATA.

Vol. IV, p. 55, change "*Peziza solemaeformis*, E. & E." to *Peziza Cazenoviæ*, E. & E., as there is already a *P. solemiiformis*, B. & C.; p. 118, line 4 from bottom, for "1168" read 1158.

Vol. V, p. 69, line 4 from bottom, for "Musie" read Music, and for "Christo" read Cristo; p. 78, line 4 from bottom, for "CYTOSPORINA" read CYTISPORINA; p. 78, line 2 from bottom, for "CYTISPORIUM" read CRYPTOSPORIUM; p. 79, line 11 from top, for "RANII" read RAUII; p. 79, line 13 from top, for "in Lett" read in Litt; p. 79, line 17 from top, for "AMORPHÆ" read AMORPHA; p. 80, in the statement "I have in the herbarium collected the previous year by F. W. Anderson, the following," insert *two* before "following;" p. 84, line 8 from bottom, for "already" read almost.

Dr. Fairman wishes the original Latin descriptions of the two following fungi, described on page 78, published:

DIDYMIUM FAIRMANI, Sacc. *Sp. nov.* Dignostitus peridiis sparsis, sessilibus, floccis hyalinis laxe recticulatis, spores levibus (8–10μ. d.); Crystallis eximie stellatis eu; Columella sub globosa fuscella.

CONIOSPORIUM FAIRMANI, Sacc. *Sp. nov.* Ab affin. *C. Apiosporiade* differt conidiis multis minoribus (5–7μ. d.) globosis, levibus, fuliginеis, 1 nucleatis.

U. S. DEPARTMENT OF AGRICULTURE.

SECTION OF VEGETABLE PATHOLOGY.

QUARTERLY BULLETIN. DECEMBER, 1889.

Vol. 5. No. IV.

THE JOURNAL OF MYCOLOGY:

DEVOTED TO THE STUDY OF FUNGI,

ESPECIALLY IN THEIR RELATION TO PLANT DISEASES.

BY

B. T. GALLOWAY,
CHIEF OF THE SECTION.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1889.

CONTENTS.

CONTRIBUTIONS TO THE HISTORY OF THE DEVELOPMENT OF THE PYRENOMYCETES.

(Plate XIII.)

BY FRANZ VON TAVEL.

(*Continued from page* 123.)

IV.—CUCURBITARIA PLATANI, *n. s.*

Among the numerous fungi which came under our observation during this investigation, we gave special attention to a *Cucurbitaria*. It was found only on the fallen *Platanus* branches and then sparingly, so that our investigations were necessarily limited to the formation of the pycnidia. For the same reason it was impossible to identify the fungus. It is here designated as *Cucurbitaria platani* n. s., because from a purely practical stand-point the object of an investigation must have a name, and because neither Saccardo nor Winter mention a *Cucurbitaria* growing upon *Platanus.*

The stroma of the fungus is circular and about 2 mm. in diameter. It lies under the bark, which becomes broken through by the perithecia and pycnidia. Generally several stromata stand close together. Twenty fruiting bodies, partly pycnidia and partly perithecia, stand in very irregular order upon a stroma. They are often very close to each other and frequently grow together. The pycnidia have very irregular cavities and thick, intensely black walls. The basidia are filiform, the pycnidia spores extraordinarily small, cylindrical, and colorless. The perithecia are flask-shaped but of very irregular form and without a distinct neck or papilla. Their walls are also black and scarcely project beyond the bark. The asci are 8-spored, cylindrical, obtuse above and suddenly tapering into a short pedicel below.

The spores are light brown at maturity, elliptical, a little smaller at the ends, and strongly constricted in the middle. They usually have six transverse septa, often more or less; the number of the longitudinal septa is very variable. They are 18–25 μ. long by 9–11 μ. broad (Fig. 13.)

The ascospores germinate rapidly even when they have been kept dry for a long time, but they behave very differently in water and in nutritive solutions. When sown in distilled water, sometimes all, and sometimes only single cells of the spore send out germ tubes which

grow rapidly for a long time. On account of the passage of the contents of the spore into the germ tube the former becomes much more transparent; its cells also swell up, but it shows no farther changes. The germ tube soon becomes divided up into short cells at its base. When the nutritive materials in the spore are used up the growth at the end ceases. The entire germ tube then divides up into roundish, much swollen cells, which produce gonidia-like buds.

The results are different when the sowings are made on gelatine which is mixed with a plum decoction, grape juice, or meat extract. The first phenomena of growth are the same. But the terminal growth of the germ tubes does not cease, and they consequently spread themselves over a relatively large area in a very short time. Their cells are therefore not short and thick but elongated, at first at least. In this case spores are not cut off.

The ascospore itself undergoes a considerable transformation. It swells up at first and becomes more transparent as happens when it is sown in water (Figs. 14–16). As the size increases new transverse septa and soon after longitudinal septa make their appearance. These septa become continually more numerous and consequently the whole spore increases in circumference; they appear in the greatest numbers in the central cells of the spore, while the ends change very little for some time. The primary cells may be visible for some time on account of the constrictions at the septa. In the manner described the spore is transformed into a large body easily visible to the naked eye and composed of a considerable number of very small cells, from which the germ tubes, which in the meantime have become large strong hyphæ, now project in different places. About six days after sowing it begins to turn brown and finally becomes so dark colored that further observations of special development are rendered impossible. It can only be seen that the cells composing the interior separate, leaving a cavity. After some time, during which the growth of the body has ceased, gonidia began to emerge from the opening in the apex. We have therefore a pycnidium situated in the center of a mycelium. A special pore which may be recognized by some especially large clear cells, is now started.

The formation of this pycnidium (it may be called a sporopycnidium in order to distinguish it from the others) does not occur when the spores are sown in distilled water; the germ tubes must therefore first grow at the expense of the spore and then take up nourishment from the substratum and carry it to the spore, in order to supply the consumption and furnish a surplus which makes it possible for it to attain such dimensions and pass through such transformations.

The sporopycnidium is a very interesting phenomenon for two reasons. In the first place it is known that by absorbing nutriment, a fungous spore may increase in dimensions and that its cells may divide De Bary (Morphol. u. Biol. d. Pilze, 1884, p. 123.) cites the *Mucorini* and

Sclerotineæ as examples of this. But such a luxuriant growth, connected with such a high degree of cell division, which simultaneously produces the growth of a mycelium from the spore, and changes the latter into a new and complicated organ of reproduction, can scarcely have been observed before.

But the case presents a further point of interest when compared with the formation of other pycnidia. We may discriminate between a symphyogenous and a meristogenous development. Pycnidia arise symphyogenously by an interweaving of hyphæ and meristogenously by the growth and division into cells of a piece of hypha in which the branches of the hypha may share. The sporopycnidium is therefore meristogenous even if it does not arise from a mycelial thread. It represents rather the most extreme case of meristogenous development, arising directly from the division and growth of the spore without the interposition of any foreign element.

Before the formation of this sporopycnidium is completed the beginnings of new pycnidia arise at the periphery of the mycelium. These are of meristogenous origin, yet several hyphæ are concerned in their construction. One or several cells swell up anywhere upon a hypha (Figs. 17–18), and these become divided by walls which are laid down both in transverse and longitudinal directions. In the vicinity of these spots the hyphæ which bound and those which accidentally cross or touch them exhibit the same changes, their cells also enlarging and dividing. In this way these hyphæ nearly fasten themselves to each other. Through continued growth and cell division there arises a many-celled compact body from which many hyphæ apparently originate; but it is from them that the body itself arose. The young pycnidia may attain considerable size without showing any cavity (Fig. 19). At first no differentiation can be seen until the walls of the superficial cells become thickened and brown. The single cells also increase in size with the growth of the whole, but the central portion finally falls behind the periphery, and the cells separate from each other in the center, without, however, as Bauke has shown for *Cucurbitaria elongata*, the process being begun by a very large definite cell. In this way there arises a cavity which enlarges with the growth of the pycnidium (Fig. 20) and is lined by uniform cells. From these grow out filiform basidia, which form a hymenium and cut off very small spores (Fig. 21). The outer wall of the pycnidium is now composed of cells whose contents have been transformed into a dark-colored mass, while the membranes themselves are less deeply colored. Here also are the beginnings of a special pore, as is the case in the sporopycnidium.

These pycnidia develop in essentially the same manner described by Bauke for *Cucurbitaria elongata;* but with this difference, that here the hyphæ which lie against the beginnings of the pycnidium do not merely form the envelope, but instead all the elements have the same functions, as is shown by cross-sections through quite young stages.

The further development of *Cucurbitaria platani* was not followed out. Secondary pycnidia began to develop on the slide in extraordinarily large numbers. The mycelium gradually became transformed into a stroma, the hyphæ continually growing darker, more closely interwoven and smaller celled. A stroma of this kind was placed with the pycnidia upon a fresh *Platanus* branch upon a place where the bark was injured. The stroma soon became completely covered with pycnidia. The peripheral hyphæ penetrated the bark, from which only a few pycnidia followed. After a long time perithecia could also be seen; but they were so few that any investigations were not to be thought of.

The ascospores of *Cucurbitaria platani* were sown upon another branch. It remained intact for a long time, but after it was apparently dead and had begun to decay pycnidia broke out upon the cut surfaces and leaf scars, in short, wherever the bark was injured. It may be concluded from this that *Cucurbitaria platani* is not a parasite but merely a saprophyte. Cultures upon leaves gave no reliable results.

MYCOLOGICAL NOTES.

By George Massee.

(Plate XIV.)

1. TREMELLA TREMELLOIDES, (Berk.) Mass. (Fig. 1). Tremelloid; lobes fasciculate, *elongated*, *suberect*, almost free to the base or variously united, *compressed*, springing from a small contracted base, *surface scabrid*, dull orange; spores elliptic-oblong with a minute oblique apiculus at the base, 11-12 by 5 μ.

Sparassis tremelloides, Berk., Grev. Vol. II, p. 6; Sacc. Syll., Vol. No. 7926.

On wood, Lower Carolina. (Type in Herb. Berk., Kew, No. 4088). Forming large tremelloid tufts, always springing from a very small basal portion, which penetrates the matrix; lobes suberect, 3-4 inches high in well grown specimens, sometimes smaller, in some specimens variously plicate and almost free to the base; in others the lobes are united laterally and form a gyrose tuft, always much compressed. The distinctly scabrid surface is very characteristic, and is due to thickly scattered papillæ, which give a very harsh feel to dry specimens. Basidia large, sterigmata developed in succession.

STELLA, Mass. (*nov. gen.*).

(Fig. 2.)

Peridium consisting of two distinct layers united at the base only; outer layer thick, splitting in a stellate manner from the apex, inner layer thin, indehiscent; gleba traversed by numerous anastomosing thin tramal plates, which are continuous with the inner wall; columella and capillitium absent; spores forming a powdery mass at maturity.

The present genus occupies an intermediate position between *Scleroderma* and *Geaster*, agreeing with the former in the structure of the gleba, which is broken up into numerous small, irregular cavities by the tramal walls, which become disorganized at maturity, and in the absence of a columella and capillitium, but is generically distinct in having a peridium composed of two separate layers, in which it agrees with *Geaster*, but is again quite distinct from the last-named genus in the total absence of a capillitium, a character which also distinguishes it from *Diplocystis*, *Diploderma*, and *Cycloderma*, if indeed the last-named genus is founded on anything more than immature species of *Geaster* collected before the splitting of the outer peridium.

2. STELLA AMERICANA, Mass. (*n. s.*). (Fig. 2.) Globoso-depressed, outer layer of peridium thick, *smooth*, *ochraceous-brown*, splitting from the apex in a stellate manner into 4–6 acute subequal segments; inner layer smooth, thin, *pale brown*, becoming disorganized above when mature; mass of spores, *umber*; walls of trama whitish, disappearing; spores globose, *minutely warted*, 6–7 μ in diameter. On the ground, Lower Carolina. (Type in Herb. Berk., Kew, along with *Scleroderma geaster*); from 1–2 inches in diameter, growing singly or sometimes two together.

3. TRICHOSPORIUM CURTISII, Mass. (Fig. 3.) Broadly effused, compact, *blackish-purple*, sometimes with a tinge of brown; hyphæ pale, septate, branched, combined into vein-like anastomosing strands; gonidia very profuse, *purple-brown in the mass*, *smooth*, *broadly elliptical*, rather variable in size, averaging 5 by 3.5–4 μ.

Reticularia affinis, B. & C., Linn. Soc. Journ., Vol. X, p. 347; Sacc. Syll., Vol. VII, Part I, No. 1426.

Reticularia atro-rufa, B. & C., Linn. Soc. Journ., Vol. X, p. 347; Sacc. Syll. No. 1428.

Reticularia venulosa, B. & C., Linn. Soc. Journ., Vol. X, p. 347; Sacc. Syll. No. 1433 (called by mistake *Reticularia venosa.*).

On bark, wood, moss, etc. Lower Carolina, Cuba, Ceylon. (All types in Herb. Berk., Kew.) Superficially resembling a *Reticularia*, but there is no cortex, the surface being perfectly naked. Forming compact cakes, 3–4 inches across and half an inch thick, consisting of a dense mass of hyphæ spreading centrifugally in the form of irregularly anastomosing vein-like strands, produced by the agglutination of hyphæ, brought about by the partial disorganization of their walls. Hyphæ septate, with numerous clamp connections, sometimes minutely scabrid with particles of lime; conidia acrogenous, produced in great profusion, becoming agglutinated into a compact cake along with the hyphal portion of the mass.

4. TRICHOSPORIUM PHYRRHOSPORIUM, (Berk.) Mass. (Fig 4.) Effused, pulvinate, compact, *deep reddish brown*, hyphæ 2–2.5 μ thick, pale yellow, septate; conidia very profuse, produced on the tips of short lateral branches, *globose*, *bright brown*, *smooth*, wall very thick, 6–7 μ in diameter.

Reticularia phyrrhospora, Berk., Journ. Linn. Soc., Vol. X, p. 347 Sacc. Syll., No. 1432.

Reticularia rubra, Ayres, in Herb. Berk.

On dead trees. Mauritius, Cuba. (Type in Herb. Berk.) Forming pulvinate masses 2–3 inches long by 1 inch or more high, seated on a broad base, convex above, sometimes irregular in outline. The conidia are produced on the tips of lateral or terminal branches, the apical cells of which become inflated, and from this inflated apical portion of the terminal cells the conidia are produced; eventually, the inflated apical cell becomes colored like the conidia, and falls away from the colorless supporting hypha; these latter are the bodies referred to by Berkeley as shortly stipitate spores.

5. TRICHOSPORIUM APIOSPORIUM, (B. & Br.) Mass. (Fig. 5.) Broadly effused, *fulvous*, hyphæ agglutinated into radiating dendritic strands; conidia *elliptical*, *minutely verrucose*, almost colorless, 8–9 by 5 μ.

Reticularia apiospora. B. & Br., Journ. Linn. Soc., Vol. XI, p. 82; Sacc. Syll., 1427.

On dead wood. Ceylon, Lower Carolina. (Type in Herb. Berk.) Broadly effused, thin; hyphæ agglutinated into irregularly branched vein-like radiating strands. The conidia spring from subpyriform apical cells as in *T. phyrrhosporium*.

6. BADHAMIA NODULOSA, (Cke. & Bal.) Mass. (Fig. 6.) Sporangia globose, stipitate, wall very thin, almost colorless above, and covered with an irregular scanty white crust of lime, basal portion without lime and beautifully iridescent, becoming irregularly ruptured at maturity; stem longer than sporangium, *weak*, *often subdecumbent*, *brown*, attenuated upwards, longitudinally wrinkled, expanding at the base into a small, irregular hypothallus; columella absent; capillitium well developed, flattened, intricately branching nodes large, irregular, *scantily furnished throughout with granules of lime;* spores globose, dingy lilac, *minutely verruculose*, 8–10 μ in diameter.

Physarum nodulosum, Cke. & Balf., in Rav. Fung. Amer. Exs., No. 479.

On Acacia bark. Aiken, S. Carolina (Rav. 2972). (Type in Herb. Kew.) A very distinct and good species of *Badhamia*, hitherto undescribed so far as I am aware. About 1.5 mm. high, stem twice as long as sporangium, weak, usually subprostrate, capillitium dense, with the characteristic flattenings met with in *Badhamia*, and everywhere containing granules of lime, although the quantity is not so great as is usual in the genus. Sparsely scattered, rarely two springing from the same hypothallus.

7. PHYSARUM SCYPHOIDES, Cke. & Balf. (Fig. 7). Sporangia globose or broadly obovate, stipitate, *upper portion of wall whitish*, rough with amorphous lumps of lime, basal portion *bright brown*, *persistent as a very shallow*, *irregular cup;* stem about equal to sporangium in length, *bright brown*, erect, usually attenuated upwards, irregularly wrinkled

and often compressed and twisted, expanding at the base into a minute brown hypothallus; capillitium dense, knots of lime white or yellowish, very numerous, large, irregularly branched, connected by short thin portions, *becoming concentrated towards the base of the sporangium to form a columella;* spores globose, lilac-brown, *minutely warted*, 7–9 μ in diameter.

Physarum scyphoides, Cke. and Balf., in Rav. Fung Amer. Exs., No. 480.

On living leaves, grass, etc. Darien, Ga. (Rav. 2407). (Type in Herb. Kew). A fine species, about 1 mm. high, scattered or gregarious, the upper portion of the sporangium whitish, chalky, with sometimes a suggestion of pink, falling away in patches when mature, and leaving the small, thicker, basal portion in the form of an irregular shallow cup or disc, which, with the character of the sporangium, suggest a leaning toward the genus *Craterium*. It is perhaps a mistake to issue new species in exsiccati before the specific diagnoses have been published.

8. TILMADOCHE GYROCEPHALA, Rost. (Fig. 8.) Sporangia stipitate irregularly globose or compressed, *variously lobed and lacunose, umbilicate below*, wall thin, at first frosted with minute greenish-yellow granules of lime, dehiscing irregularly; stem equal to or longer than sporangium, attenuated upwards, strongly wrinkled longitudinally, expanding downwards into an irregular hypothallus, *yellow or orange;* columella absent, capillitium well developed, forming a rigid, irregular net-work; *swellings small, fusiform*, containing yellow granules of lime; spores globose, dingy lilac, *minutely verruculose* 9–12 μ in diameter.

Tilmadoche gyrocephala, (Mont.) Rost. Mon., p. 131; Sacc. Syll., No. 1248.

Physarum Schumacheri, Spr., Rav. Fung. Amer. Exs., No. 4778.

Didymium gyrocephalum, Mont., Ann. Sci. Nat., Ser. II, Vol. VII, p. 362; Mont. Syll., No. 1073.

Cribraria straminiformis, Speg., Fung. Arg., pug. II, No. 109.

On twigs, leaves, etc., Brazil; Argentine Republic; S. Carolina.

Scattered or gregarious 1.5 to 2 millimeters high, characterized by the *gyrose* and *lacunose sporangium*, which, judging from the simple, thin stem, is not an æthalium, as is the case in some species of *Trichia*, *Hemiarcyria* and other genera, where the clustered and fasciculate compound stem proves conclusively the ethaloid nature of the complex sporangium.

KEW, ENGLAND.

A PRELIMINARY LIST OF THE ERYSIPHEÆ OF MONTANA.

By F. W. ANDERSON.

Whatever effect the abundance or scarcity of rain, or the degree of atmospheric and terrestrial humidity from other sources, may have upon the propagation of *Peronosporeæ* and *Uredineæ*, it is certain that the *Erysipheæ*, in Montana at least, are not very materially affected by even an unusual lack of such moisture. Montana this year, in company with many other Western States, has suffered from an almost unprecedented drought. Yet, while all ordinary vegetation languishes, and while *Uredineæ*, usually so abundant everywhere, are hard to find, the *Erysipheæ* have appeared on most of their usual hosts in fair abundance.

In looking over the published Lists of *Erysipheæ* from various States, or in comparing herbarium specimens of a given species on the same or different hosts from a number of States, one is struck at once by the wide range of variation in the specific characteristics of that species. This is especially noticeable where a species has a wide geographical distribution and a great number of hosts belonging to different families. In fact, it is frequently a difficult task to assign some of these forms which may be intermediate between two related and variable species. For example: Within the range of the two common species of the genus *Erysiphe*—*E. communis* and *E. cichoracearum*—we find at times the most perplexing variations of all kinds, from the form and disposition of the mycelium, up to the number and size of the asci and spores. One is sometimes tempted to think that they are but one "running" species, or else that some day an intermediate specific rank will be erected to embrace the more radical of the intermediate variations from the two types. One or the other alternative must sooner or later be adopted in order to find a resting place for some of the Rocky Mountain forms which are clearly neither the one nor the other, but which are certainly intermediate. There are species in other genera also which would be made easier to deal with by a similar modification. I hope in a future paper to discuss our peculiar Rocky Mountain forms more fully, and with this object in view it may not be out of place at this time to ask botanists of the Rocky Mountain region to send me specimens of the species and forms common to their several localities. I should be happy to send them good specimens from Montana in exchange.

This short preliminary list is published with the hope that other resident or traveling botanists in Montana may be stimulated to a more earnest study of this important family. The species have been collected by myself on the hosts and in the localities given except as otherwise indicated. Spring Hill is on the Idaho border at the southwest, west of the main divide. The Valley of the Teton is near the British line

at the north and east of the main divide. Montana contains 143,776 square miles, and is more than twice as large as all the New England States put together, so that some of our species have a very fair range. I have found that where a host common throughout both sides of the main divide of the Rockies occurs, the fungus will be found throughout also.

SPHÆROTHECA MORS-UVÆ, (Schw.) B. & C. Hosts: *Ribes floridum*, Helena (Kelsey); *R. cereum*, Helena and Great Falls; *R. rotundifolium*, Sand Coulee. Mycelium at first white, but soon becoming dark brown, forming a dense felt over the succulent twigs and young leaves of *Ribes rotundifolium;* occurring also upon the berries. On *Ribes cereum* it is less frequent, and usually grows in small isolated belts around the young twigs. At times very injurious to the gooseberry. Unusually prevalent this year.

SPHÆROTHECA CASTAGNEI, Lév. Hosts: *Geranium incisum*, Helena (Kelsey), Sand Coulee, Belt Mountains; *Geranium Richardsoni*, Belt Mountains; *Gilia linearis*, Sand Coulee, Belt Mountains, Helena, Deer Lodge, Willis, Glendale, Dillon, Spring Hill, and Valley of the Teton; *Gilia gracilis*, Belt Mountains; *Shepherdia argentea*, Valley of the Teton, throughout on *Gilia linearis*, frequently killing it; covering all parts of the plant above ground. The thousands of black perithecia, mixed with the gray mycelium, make infested plants look as if covered with small particles of black soil mixed with dust. Rare on *Gilia gracilis*. On *Shepherdia argentea* the disposition of the mycelium was much like that of *Sphærotheca mors-uvæ*; but more delicate, colorless, or faintly creamy-yellow tinged, and not so evident; that is to say, it attacks the tender twigs of the tree and surrounds them, causing injury to the leaves above by perversion of nutrition. It is also very partial to the leaf axils. My specimens were collected July 16, this year. The ascospores are formed, but the fungus is not mature. Mr. J. B. Ellis, who kindly compared my specimen with one from Dr. Farlow, agrees with me that it must be referred as above. Common in the mountains on *Geranium incisum* and *G. Richardsoni*, often thickly covering the petioles, leaves, stems, and even the petals, sometimes causing the leaves to curve to the ground with the weight of fungus and destroying them.

A quite remarkable form of this species was found on *Heuchera parvifolia*. Anderson No. 212. Sand Coulee, Cascade County, Mont., December 3, 1888. Its most marked peculiarity is in the mycelial threads, which have a tendency to grow to a great length without ramifying to any extent, and end in long, slender, cylindrical, colorless threads. Moreover, they show marked constrictions at nearly regular intervals, at which they are septate. The appendages can be readily distinguished from the mycelium, are strongly colored for about one-third to one-half their length, and then gradually fade to the almost hyaline tip. Like the mycelium, they are septate and show a tendency to elongate without

interweaving much with other threads. Conidia-bearing branches are scarce, and the only perfect (?) one I could fine bore three conidia.

ERYSIPHE COMMUNIS, (Wallr.) Fr. Hosts: *Œnothera albicaulis*, Sand Coulee; *Oxytropis Lamberti*, Sand Coulee, Great Falls, Valley of the Teton, Craig, Helena, Deer Lodge, Dillon, Spring Hill; *Astragalus Canadensis*, Helena (Kelsey), Belt Mountains; *A. multiflorus*, Belt Mountains; *A. decumbens*, Belt Mountains; *A. hypoglottis*, Sand Coulee, Helena, Willis; *Pisum* (cultivated), Willis, Spring Hill; *Vicia Americana*, var. *linearis*, Sand Coulee; *Trifolium longipes*, Deer Lodge Valley and Belt Mountains; *Lupinus parviflorus*, Deer Lodge and Spring Hill; *Amelanchier alnifolia*, Helena (Kelsey), Sand Coulee; *A. maculatum*, Sand Coulee; *Ranunculus repens*, Helena, Deer Lodge, Willis; *R. macranthus*, Great Falls, Belt River; *R. Cymbalaria*, Sand Coulee, Helena, Deer Lodge, Dillon, Willis, Glendale, Melrose, Spring Hill, Valley of the Teton; *R. sceleratus*, Sand Coulee, Helena. Doubtless on many other hosts. The forms on *Ranunculaceæ* commonly have very dark appendages, especially the form on *R. Cymbalaria*. The appendages of the forms on *Leguminosæ* are lighter or even entirely colorless, and often indistinguishable from the mycelium at maturity. This fungus is especially destructive to *Ranunculus Cymbalaria*, *Oxytropis Lamberti*, and cultivated *Pisum*.

ERYSIPHE GALEOPSIDIS, DC. Host: *Stachys palustris*, Helena (Kelsey), collected August 26, of this year, but not well matured. The abundant mycelium develops on all parts of the plant above ground. Occasionally asci are seen nearly double the ordinary length, constricted at the middle and septate; they were seen (several in one perithecium and one or two in others) clustered with the other asci. The spores, which are not mature, are usually narrowly elliptical to linear and acute at both ends.

ERYSIPHE CICHORACEARUM, DC. Hosts: *Mertensia Sibirica*, Belt Mountains; *Phacelia Menziesii*, Silver City (Kelsey); *Parietaria debilis*, Sand Coulee; *Verbena hastata*, Helena (Kelsey); *Galium Aparine*, Sand Coulee; *Echinospermum Redowskii*, Helena (Kelsey); *Solidago Missouriensis*, Sand Coulee, Belt Mountains; *S. serotina*, Sand Coulee, Belt Mountains, Helena, Deer Lodge, Dillon, Spring Hill; *S. rigida*, Sand Coulee, Belt Mountains, Belt River, Craig, Helena, Deer Lodge, Butte, Silver Bow Junction, Dillon, Willis, Spring Hill, Valley of the Teton; *S. nana*, Belt Mountains; *S. occidentalis*, banks of the Upper Missouri River; *Aster lævis* and forms, Sand Coulee, Belt Mountains, Helena, Deer Lodge, and Dillon; *A. conspicuus*, Belt Mountains; *A. longifolius*, Belt Mountains, Helena, Warm Springs Asylum; *A. commutatus*, Sand Coulee, BeltRiver, Cora Creek Station, Great Falls, Helena, Deer Lodge, Dillon, Willis; *A. canescens* and forms, Sand Coulee, Belt Mountains, Belt River, Mt. Helena, Deer Lodge, Warm Springs Asylum, Spring Hill; *A. multiflorus*, Belt River, Otter Creek, Cora Creek Station; *A. foliaceus* and vars., Sand Coulee, Helena, Deer Lodge, Dillon, Warm Springs Asylum; *A. adscendens*, Belt River; *Erigeron macranthus*,

Elkhorn (Kelsey), Belt River, Belt Mountains, Sand Coulee, Helena, main range of the Rockies, Deer Lodge, and Willis; *E. glabellus*, Belt Mountains; *E. divaricatus*, Sand Coulee, Belt Mountains; *E. Canadensis*, Sand Coulee, Helena, Dillon; *E. corymbosus*, Belt Mountains; *E. armeriæfolius*, Helena; *E. strigosus*, Sand Coulee; *Helenium autumnale*, banks of the Big Hole River, near Willis; *Helianthus annuus*, Helena (Kelsey); *H. Californicus*, var. *Utahensis*, Helena (Kelsey); *Gaillardia aristata*, Mount Helena; *Lactuca pulchella*, Sand Coulee; *Artemisia dracunculoides*, Belt Mountains, Belt River, Cora Creek, Otter Creek, Chinook, Valley of the Teton, Sun River, Fort Shaw, Fort Assinniboine, Sand Coulee, Craig, Helena, Garrison, Deer Lodge, Butte, Silver Bow Junction, Silver City, Willis, Melrose, Glendale, Spring Hill; *A. Ludoviciana*, Belt Mountains, Valley of the Teton, Belt River, Otter Creek, Helena, Craig, Deer Lodge, Dillon, Warm Springs Asylum, Willis, Great Falls, Sand Coulee, Sun River; *A. discolor* and forms, Belt Mountains; *Bigelovia graveolens* and vars., Falls of the Missouri River, Helena, Deer Lodge, Warm Springs Asylum, Dillon, Glendale, Melrose, Willis, Chinook, valley of the Teton, Spring Hill; *B. Douglasii* and forms, Mount Helena, McCarthy Mountains, Willis, Deer Lodge, Spring Hill; *Chrysopsis villosa* and forms, Sand Coulee, Deer Lodge, Willis; *Grindelia squarrosa*, Sand Coulee, Helena, Deer Lodge, and Willis; *Cnicus undulatus*, Sand Coulee, Helena, Deer Lodge, McCarthy Mountains near Willis, valley of the Teton; *Gutierrezia Euthamiæ*, Sand Coulee and Deer Lodge.

A number of the forms of *Erysiphe cichoracearum*, DC., to be found on the hosts given are far from typical—especially on certain of the *Compositæ*, and are placed here because at present there is no other place to put them. In some, one, in others another character fails, and again nearly all may fail; not the least important of which is to be considered the remarkable variation in the number of spores to an ascus. In the *Verbena hastata* specimens the asci contain frequently but one spore and that of but average size. The perithecia of *Phacelia Menziesii* specimens are very dark, in marked contrast with the rather pale appendages. All parts of the plant are overrun by the fungus. The fungus covers *Echinospermum Redowskii* entirely. Sometimes large patches of the host growing in dry gravelly places along railway tracks are almost white with growth of mycelium. *Parietaria debilis* suffers so severely from this fungus that its leaves rot on the stems, and if one attempts to pull a leaf off it is no uncommon thing for an irregular piece to come away between one's fingers, leaving the other dilapidated portion still hanging. In *Compositæ* the *Artemisiæ*, with *Aster foliaceus*, *Aster canescens*, and *Aster commutatus* suffer most severely. Cultivated plants do not appear to be infected. In connection with the fungus on *Cnicus undulatus*, collected at Helena, I found the conceptacles of *Cicinobolus Cesatii*, DBy. They were confined chiefly to the conidia-bearing hyphæ, pale in color and small, probably young, for no spores were seen to

escape from crushed conceptacles. They produced no perceptible distortions in the form of the host hyphæ, their own hyaline, delicate mycelium running along the center of the hyphæ for great lengths. I regret that no drawing or fuller notes were preserved. Recently, I have found the same fungus in the hyphæ of *Erysiphe cichoracearum*, DC., on *Gutierrezia Euthamiæ.* The host mycelium was much distorted; here and there colored brown and containing a brownish granular substance—probably the forming conceptacles of the *Cicinobolus;* while, at intervals, the mature conceptacles, varying much in size, arose directly from the usually prostrate hyphæ. Some of these conceptacles were larger than the half-grown perithecia of their host. Their mycelium appeared to ramify with the ramifications of the host mycelium and the conceptacles were most frequently developed near the terminal of a host hypha, or at the terminal of one of its branches, or sometimes from the center of a hypha. Although young and half-grown perithecia of the host were in fair abundance, there was a great scarcity of vegetative mycelium, unusual in this species on any of our hosts. Conidia were also scarce, and it is extremely probable that they were prevented from so much as partially forming by the fructification of the *Cicinobolus* taking possession of the conidial branches at an early stage of their growth. The *Cicinobolus* spores could be found in great numbers, issuing from the ruptured conceptacles. They varied somewhat in shape, occasionally slightly constricted at the middle; usually straight and oblong or narrowly oval. They soon scattered in every direction under the cover glass. None of them appeared to be nucleate.

ERYSIPHE GRAMINIS, DC. Hosts: *Glyceria nervata*, Sand Coulee; *G. aquatica*, Sand Coulee; *Agrostis exarata*, Sand Coulee; *Beckmannia erucæformis*, Sand Coulee; *Hordeum jubatum*, Sand Coulee; *Poa tenuifolia*, Sand Coulee, Helena, Deer Lodge, Willis, and Spring Hill; *Agropyrum glaucum*, Sand Coulee, Great Falls, and Sun River Valley. This common fungus has been found to have mature ascospores in October on *Beckmania erucæformis*, *Hordeum jubatum*, and *Poa tenuifolia.* Perithecia varying in size have been found on all but the *Agrostis exarata.* On *Poa tenuifolia* the ascospores are mature by November, and usually by the middle of October. Professor Galloway informs me that in Missouri, on another species of *Poa*, this fungus was found by Prof. S. M. Tracy containing ripe ascospores in July. In the forms on all the grasses mentioned excepting *Agropyrum glaucum*, the mycelium is at first snow white, and so far as seen never turns yellow or brown, although with age it may assume a grayish tint. The fungus occurs mainly on the upper surface of the leaves in *Beckmannia erucæformis* and *Hordeum jubatum;* on the other grasses it is found abundantly on both surfaces. The form on *Agropyrum glaucum* is colored, almost if not quite from the first, and soon becomes brown or even rusty red, dense and felted, forcibly reminding one of the mycelium of *Sphærotheca mors-uvæ* by its appearance *en masse.* In pressing or drying it loses much of its characteristic appearance.

I have not examined the perithecia of specimens collected later than August, at which period the spores are unformed, or at most only just beginning to show around the inner wall of the ascus. So far as this could be studied it accorded better with the description of the European plant than most of those in my herbarium bearing the same name from any American locality. But none of ours that I have seen agree with the number of asci given in the description "asci 8–16," while ours are 10–25, commonly the greater number. The form on *Poa tenuifolia* does not at all accord with the description and may yet be separated as a good species. This fungus is remarkably destructive to the *Poa* and may be found literally covering it—as if a bucket of whitewash had been spilt over the grass—even on dry, gravelly hills from 7,000 to 9,000 feet high. Deer Lodge Valley is in altitude over 6,000 feet and the high hills and mountains in the vicinity, which are dry and nearly bare of other vegetation than a sparse growth of this grass, form a rich collecting ground for various *Erysipheæ*. *Erysiphe graminis* on *Poa tenuifolia* will be found an excellent subject for those who wish to study the development of the mycelium from the conidia and the sexual organs and ultimate fruit from the mycelium.

UNCINULA SALICIS, (DC.) Winter. Hosts: *Salix glauca* (a form) Helena (?) (Kelsey), Belt Mountains; *S. rostrata*, Belt Mountains; *S. longifolia*, banks of the Upper Missouri River, and Dillon; *S. amygdaloides*, banks of the Upper Missouri River, valley of the Teton, and Sun River Valley; *S. cordata*, banks of the Upper Missouri River; *S. flavescens* and vars., Belt Mountains, Helena, Deer Lodge, Warm Springs Asylum, McCarthy Mountains, Melrose, Spring Hill; *Populus tremuloides*, Sand Coulee, Helena, Deer Lodge, Willis, Spring Hill; *P. monilifera*, banks of the Upper Missouri River, Deer Lodge, Dillon, Willis; *P. balsamifera*, Deer Lodge, Dillon, Willis, Spring Hill; *P. angustifolia*, Helena, Deer Lodge, Willis. This beautiful species is widely distributed and varies considerably on the different hosts, especially as regards appendage tips and number of spores in an ascus. In some instances the appendage tips are almost straight and scarcely swollen in well matured specimens; but such variations are to be expected and are of no specific importance within certain limits.

PHYLLACTINIA SUFFULTA, (Reb.) Sacc. Hosts: *Heuchera parvifolia*, Sand Coulee; *Typha latifolia*, Helena; *Betula occidentalis*, Helena (Kelsey); *Cornus stolonifera*, banks of the Upper Missouri River, Helena, Dillon, Willis, Spring Hill; common and variable; sometimes causing marked injury to the leaves of hosts.

PODOSPHÆRA OXYACANTHÆ, (DC.) DBy. Host: *Prunus Virginiana*, Sand Coulee, Mount Helena. More prone to attack the leaves of vigorous shoots in shady places. Not particularly abundant.

MISCROSPHÆRA SYMPHORICARPI, Howe. Hosts: *Symphoricarpus occidentalis*, Sand Coulee, Belt River, Sun River Valley, Craig, Helena, Deer Lodge, Dillon, banks of the Big Hole River near Willis, banks of

the Red Rock River near Spring Hill, Valley of the Teton; *S. racemosus* var. *pauciflorus*, Belt Mountains. More prolific on the former host; sometimes covering both surfaces of the leaves, causing them to fall before their season.

MICROSPHÆRA GROSSULARIÆ, Lév. Hosts: *Ribes rotundifolium*, Sand Coulee; *R. floridum*, Sand Coulee and Helena; *R. nigrum* (cult. black currant), Sand Coulee. The perithecia and contents usually mature in late autumn, when the leaves begin to fall.

MICROSPHÆRA RAVENELLII, Berk. Hosts: *Astragalus adsurgens*, Sand Coulee, Helena, Deer Lodge, Spring Hill; *Vicia Americana*, var. *linearis*, Sand Coulee, Helena, Deer Lodge, Willis, Belt Mountains, and the Valley of the Teton. Very abundant on the latter host, stunting its growth and preventing the production of flowers.

It will be evident from the following table that there are still many common and good-sized families whose members are attacked by *Erysipheæ* that are not represented in our list. Active workers may expect a rich harvest in Montana for several years to come. The work is in its infancy here, and the only active students are Mr. Kelsey and myself. We want more in the field. I have made several flying trips to points all over the Territory, only getting together a dozen species on ninety odd different hosts. What we need is more local collectors who can do thorough work in their own vicinities. This want will doubtless be supplied as our new State grows older.

Orders represented among host plants.	Number of genera in the order.	Number of species in the order.
Ranunculaceæ	1	4
Geraniaceæ	1	3
Sapindaceæ	1	1
Leguminosæ	4	10
Rosaceæ	2	2
Saxifragaceæ	2	5
Onagraceæ	1	1
Cornaceæ	1	1
Caprifoliaceæ	1	2
Rubiaceæ	1	1
Compositæ	11	35
Polemoniaceæ	1	2
Hydrophyllaceæ	1	1
Borraginaceæ	2	2
Verbenaceæ	1	1
Labiatæ	1	1
Elæagnaceæ	1	1
Urticaceæ	1	1
Cupuliferæ	1	1
Salicineæ	2	10
Typhaceæ	1	1
Gramineæ	6	7
Total in twenty-two orders	44	93

rysipheæ represented by 6 genera and 13 species.

STATUS OF THE SORGHUM BLIGHT.

By W. A. KELLERMAN and W. T. SWINGLE.

Attention is called to two papers, whose titles in full are as follows:

(1) *Notizie preliminari sopra alcuni fenomeni di fermentazione del Sorgo saccarino vivente* (Preliminary notice concerning phenomena of fermentation in living saccharine sorghum). *Nota dei Socii corrispondenti Palmeri e Comes. Adunanza del dì* 1° *dicembre* 1883. *Estratto dal Rendiconto della R. Accademia delle Scienze fis. e mat. di Napoli. Fascicolo* 12° *dicembre* 1883.

(2) *Una Rivendicazione di Priorità sulla Malattia del Sorgo saccarino* (A vindication of priority concerning the malady of saccharine sorghum). *Pel Socio Dr. O. Comes. Adunanza del dì* 8 *agosto* 1889. *Estratto dal Rendiconto del Reale Istituto d' Incoraggiamento. Fascicolo* 7° *e* 8° *luglio e agosto* 1889.

The authors of the first paper, Professors Palmeri and Comes, noticed in 1882 in the expressed juice of saccharine sorghum minutè forms similiar to ferments, but they made no further observations in regard to the same until the following year. In 1883 they found at Castellammare (Italy) that the canes presented a conspicuous coloration ; in some cases the whole interior portion of the cane was red. This condition gave rise to the suspicion that here was presented the effect of the attack of *Ustilago Reiliana*, Kühn. But on the other hand, they noticed an increase of temperature in a bundle of canes, which was still more marked in a heap of reduced cane awaiting the extraction of the juice. The juice obtained was red in color and immediately underwent spontaneous alcoholic fermentation which was accompanied, or at least immediately followed, by an acetic fermentation. Examination was then made to determine whether fermentation took place in the juice previous to its extraction. For this purpose a cane was made use of that had been in store for eight days. It was cut into small pieces, put into water and subjected to distillation. The distilled liquid gave an alcoholic odor and furnished also, with Muntz's method, evidence of alcoholic content.

Professors Palmeri and Comes then sought to determine whether similar results would be obtained both in the vigorous growing canes attacked with the *Ustilago*, and also in healthy and uninfected plants. They took for this purpose from a farm at Ponticelli a few plants presenting the red discoloration, and others that showed no signs of the disease. Distillation one hour later resulted in the detection of alcohol in the case of the red canes, but none was found in case of the normal and healthy plants.

Sound canes were uniformly found to be white within, but affected ones were a red orange color. The coloration appears first in the fibro-vascular bundles. It is light yellow, but in marked contrast to the

adjacent tissue. Later the color deepens to a more or less intense orange, and the fibro-vascular bundles appear as red lines. Finally the adjacent tissue also becomes colored, first at isolated points and then throughout. At this stage the fibro-vascular bundles become altered to a brown color. The red coloration may be manifest, both in the tissue of the internode and in the leaf sheath, or it may be limited to the leaf sheath. In the latter case the corresponding fibro-vascular bundles of the internode are slightly yellow, and those of the leaf sheath are violaceous. But if the internodes and leaves are contemporaneously reddened it was found that the fibro-vascular bundles of the leaves first redden; then the coloration passes along the bundles into the stems. If the node be examined in longitudinal section the red strands will be seen entering from the leaf sheath. In fact the fibro-vascular bundles (with the surrounding tissue) are colored their entire length, and the coloration passes from the leaf to the node, thence with the elaborated sap through the internodes.

Upon microscopic examination the investigators found the red coloration to be due to a deposit on the cell walls. Under strong magnification colorless micro-organisms of various sizes and forms were detected. The larger ones were elliptical, the smaller almost spherical and highly refractive. The first propagate by budding and appear in colonies of two or three individuals united by germination. Some of them are homogeneous, but many present a luminous point in the center or a point at each end; still others have three points, namely, one in the middle and one at each end. The presence and number of these luminous points depend on the stage of development of the cell. Their length (5–7μ) is about twice their breadth (2–3μ).

These micro-organisms, according to Professors Palmeri and Comes, probably correspond to the species figured by Bonorden, Handb. All. Mykol. taf. I Fig. 2 and called *Hormiscium sacchari*. This ferment is very probably the same as that which was afterwards named by Rees *Saccharomyces ellipsoideus*. The spherical or subspherical micro-organisms mentioned above are scarcely 1μ long and present an active vibratory movement. They should perhaps be referred to *Bacterium termo*, Djr., which is commonly found in juices and tissues undergoing decay.

A positive demonstration of the mode of entrance of the germs into the tissue is not claimed, yet it was suspected from observations above given that they enter from without—which is corroborated by the following. "Not only is there a whitish cereous coating, but also another, especially under the sheaths of the affected stems, which is frost-like, greasy white, and cinereous. Microscopic examination reveals the fact that this lime-like coating consists of myriads of organisms like those found in the juices. The diseased plants remaining on the ground afford in their amylaceous or saccharine contents opportunity for increase of the micro-organisms, which are then finally wafted hither and

thither by the breezes. Disseminated in this manner they reach the leaves of the sorghum plants, upon which, in the presence of mists and rain, they multiply and pass through casual wounds or through stomates into the leaves, thence with the elaborated sap to the tissues of the stalk." This hypothesis is supposed to be justified further by the observation that the disease was more intense during the spring fogs and on manured soil where the development of such germs is common. This was the case at Castellammare, where the material for study was obtained.

We have thus given in detail the account of these interesting investigations (in fact this may be considered for the most part merely a free translation of the paper) though carried on five years ago, for the reason that no extended notice of the same has hitherto been given in this country. It was reviewed in the *Botanisches Centralblatt* XXIII, 19 (1885).

In the second paper "Vindication of Priority," Dr. O. Comes, after referring to Professor Burrill's and our own investigations of the Sorghum disease, calls attention to his researches published in 1883 and maintains most positively that the disease studied by himself and Professor Palmeri is the same as that discovered by Professor Burrill in Illinois and further studied by us in Kansas.

Professor Burrill's accounts are as follows: "A Disease of Broom-corn and Sorghum," in the eighth annual meeting of the Society for the Promotion of Agricultural Science, 1887, pages 30–36, and in the Fourteenth Report of the Board of trustees of the University of Illinois for the two years ending September 30, 1888, pages 215–222; and "Disease Germs; another illustration of the fact that bacteria cause disease," in The Microscope, Vol. VII, No. 11, pages 321–331, taken from the Transactions of the American Society of Microscopists, 1887. Our accounts are as follows: "Preliminary Report on Sorghum Blight" in Experiment Station, Kansas State Agricultural College, Bulletin No. 5, pages 56–60, December, 1888; and "Sorghum Blight" in the First Annual Report of the Kansas Experiment Station, State Agricultural College, for the year 1888, pages 281–315.

It is not so clear to us as it is to Dr. Comes that the disease detected by him is the same as that studied by us, and for conclusive evidence we await further investigation on both sides. Dr. Comes dealt with a form of disease characterized by evident alcoholic (and acetic) fermentation. No fermentation whatever was detected either by Professor Burrill or ourselves. Stress it seems to us should be laid on this fact.

He says, in reference to the microbe which he found, that he first thought he had to do with a saccharomycete, but convinced himself the following year that it was a schizomycete and referred to *Clostridium butyricum* (Pasteur), Praz. in "*Il marciume delle radici e la gommosi nella vite*, Napoli, 1884" We would note in reference to this species that ac-

cording to Prazmowski, "*Untersuchungen über die Entwickelungsgeschichte und Fermentwirkung einiger Bacterianarten* and the description in Schrœter's "*Kryptogamen-Flora Schlesiens,*" III, Band, Pilze, S. 166, it is a very different organism from *Bacillus sorghi*, Burrill. As figured by De Bary, "Lectures on Bacteria," 2nd. Ed., English translation, page 100, Fig. 13, it somewhat resembles the form shown by us, Plate IV. Fig. 5, *l. c.* which is wholly unlike *Bacillus sorghi.* In the latter no germination of the spores could be seen, while in *Clostridium butyricum* they are said to germinate from the end and are so figured by Prazmowski, *l. c.*

Dr. Comes further says that not having material at hand at the time of writing the "Vindication" he was unable to confirm his former reference of the microbe to the one previously described or to determine whether it be new (*Bacillus sorghi*) as Professor Burrill decided. He says that the description and figures given by Bonorden correspond precisely to the microbe under examination, and also states that his own description of the organism corresponds exactly to that made by Burrill, and to the Figures 1, 2, 3, 4, 5, and 6, Plate IV, of the Report of the Botanical Department of the Kansas Experiment Station, 1888, except that his is a little larger than ours. Now, it should be noticed that whereas our Figures 1, 2, and 3 represent the *Bacillus sorghi*, Figures 5 and 6 represent Bacilli very different in size and character and only occasionally found as impurities in cultures.

The difference in size of the micro-organisms found by Dr. Comes and of *Bacillus sorghi* is by no means inconsiderable. His were $5–7\mu$ long and $2–3\mu$ wide. The measurements of *Bacillus sorghi* are only $1\frac{1}{3}–4$ by $\frac{1}{2}–1\frac{1}{4}\mu$, mostly $1\frac{1}{12}–3$ by $\frac{3}{4}–1\mu$. Moreover, if Bonorden's figures (taf. I, Fig. 2, and description of species page 33, *l. c.*) be examined it will be seen that they are very different from our figures of *Bacillus sorghi* referred to by Dr. Comes, and Bonorden's can not for a moment be regarded as representing the species with which we had to deal.

The *Micrococcus* figured by us (Plate IV. Fig. 4. *l. c.*) was also found by him and referred to *Bacterium termo*. The figure alluded to, no less than our (unpublished) description of the organism, shows that it is not *Bacterium termo*, but a *Micrococcus* measuring only $\frac{1}{2}–\frac{3}{4}\ \mu$ in diameter.

The interior tissue of the cane when diseased (and the disease appeared within only where the stalk had been wounded) was uniformly colored in specimens examined by us. We found in no case colored fibro-vascular bundles surrounded by white tissue. Dr. Comes found the fibro-vascular bundles either light yellow or highly colored and surrounded by white tissue.

The disease in Italy was found in the saccharine sorghum, presumably *Sorghum saccharatum;* that which we studied is in *Sorghum vulgare*, and so far as known to us at present does not occur on *Sorghum saccharatum.*

Finally we observe that the symptoms of the sorghum disease reported by Dr. Comes do bear, at least superficially, a marked resemblance to sorghum blight studied by us, yet at the same time the microbes appear to be quite different. At any rate a fuller diagnosis, showing more points of resemblance, may perhaps reasonably be expected in order to establish the identity of the disease occurring in Italy and in the United States.

NOTE BY T. J. BURRILL.

Through the kindness of Professor Kellerman I have had an opportunity to examine the manuscript by himself and Mr. Swingle in reply to the respectful claim of priority on the part of Dr. Comes in the matter of sorghum blight. The reply seems to me well made and fairly states the case upon both sides. I will here say that I had seen the notice in the *Botanisches Centralblatt*, XXIII. 19 (1885), before my first paper upon the subject was published, and really intended to refer to it. However, it seemed certain to me that the disease there alluded to could not be that with which I was engaged. This certainty was the primary cause of the omission of my intended reference, since I filed my note made at the time of reading the article among those of general plant diseases instead of among those due to bacteria, and thus overlooked it when the manuscript was prepared. Further, the tissues of growing sorghum plants are very likely to turn red when injured in any way, even by mechanical wounds, while the fact that alcohol was cited as a product and a *Saccharomycetes* as an agent clearly separated the characteristics of the diseases studied. It is certain that alcohol is not found directly connected with what is called sorghum blight in America. It seems to me impossible that any one could mistake the organism described as the cause of this last for either *Bacterium termo* or *Clostridium butyricum*, not to speak of a *Saccharomycetes*.

However, if this sorghum blight was really investigated in Italy before it was in America, no one will more cheerfully accept the fact than myself whether or not the authors properly described what they saw.

ROOT FUNGUS OF NEW ZEALAND.

By R. Allan Wight.

This fungus in the mycelial stage attacks a great variety of tree roots, amongst the most conspicuous of which are the apple, pear, peach, and all other common orchard trees. The white thorn is also very subject to its attacks, as well as a great many *Abies* and several of the native trees and plants. It also attacks the cabbage, the potato, docks, sorrel, fern, and in fact is almost omnivorous, which is a marked peculiarity.

The only plants I have ever known to resist it are resinous pines and roses; the former suffer at first and the leaves turn yellow, but they ultimately recover, and I never knew one to succumb, whereas the contrary is the case with all other plants attacked.

In hedges of white thorn where roses have been planted at intervals, the thorns are killed and the roses remain intact and quite uninjured. In an orchard it will appear in patches, killing the fern and sorrel and spreading until it reaches a fruit tree; it then attacks the bark round the stem just under the ground, which speedily rots, presenting the appearance of having been cooked, and has an offensive smell; it then proceeds along the roots and the tree soon shows withered leaves, which drop off, leaving it bare, and by and by it falls over and lies on the ground. Its movements are uncertain; sometimes a tree here and there dies; sometimes a whole row and very often acres are swept off. Many entire orchards of fine trees are killed in a few years. This fungus is never found in clay or other damp soils, but always in dry friable lands. Professor Kirk of Wellington says it is *Lycoperdon gemmatum*, Batsch., and that "tar water" is a certain cure. The last statement is assuredly an error, and I think the first is also. For a great many years I have endeavored in vain to procure the fruit of this fungus, using all the means that suggested themselves to me, without any success. I have seen large quantities of the *L. gemmatum* growing in orchards where there is no root fungus, and I have seen a very great many orchards and watched several closely where hundreds of trees are attacked and could never find the mycelium connected with the *Lycoperdon*.

The pest is most plentiful on the skirts of the primeval forests and on fern lands adjoining where no cultivation has ever been resorted to. Whole crops of potatoes are destroyed on such lands, and on dry lands where native tree stumps remain it is very prevalent. My own opinion is that it is a fungus native to and probably peculiar to New Zealand (in the North Island only). All my experiments with sulphur and lime have failed. Kerosene-oil used in winter has alone been of any use, and that has been used pure in winter without killing the tree. The fungi of New Zealand are legion and very destructive, but this is the worst, and particularly as it is confined to dry soils. Where I am now writing 500 trees have been killed within the last two years, and all remedies tried have failed. The apple-scab, the shot-hole fungus, the oidium of the vine are terrible pests in New Zealand, and the settlers have more to to fear from fungous growths than insect pests.

AUKLAND, NEW ZEALAND.

SOME NOTES UPON ECONOMIC PERONOSPOREÆ FOR 1889 IN NEW JERSEY.

By Byron D. Halsted.

Early in the season as announced in the *Botanical Gazette* for June, page 152, a peronospora was found upon cucumber leaves growing under glass here in New Brunswick. The disease assumed a violent form, and in the course of a few weeks all the vines were dead. Squash seed was afterwards sown in the same bed to determine whether the peronospora would develop upon this near relative of the cucumber. In the meantime the mildew, which seemed to be new, was studied; the method of germination by zoospores, and other points were determined and specimens with drawings were afterward sent to Dr. Farlow.

An account of this peronospora was given by Dr. Farlow in the *Botanical Gazette* for August, page 189, in which it was stated that the same species had been found a few months before in Japan, and that it was *Peronospora Cubensis*, B. & C., first found in Cuba on *Cucurbitaceæ*, and described several years ago.

Leaving aside the interesting fact of the widely separated points where this fungus has been found the readers attention is called to the economic side of the question, for not only were the squash leaves of plants growing in the hot-bed infected, but squash and pumpkin vines in various parts of the State were seriously attacked. The writer made it a point to look for this mildew as he visited various counties, and in all cases it was met with, and in some instances was so abundant as to discolor and destroy the leaves before they had attained full size.

The squash plant, from its habit of growing horizontally upon the ground and bearing large, widely separated leaves, is an easy one upon which to study the development of this fungus. It was never found upon the young leaves, but it followed some distance after and became manifest, for example, upon the fourth or fifth leaf from the extremity of the vine. The greenish yellow patches are first seen, and these are small and irregular in shape, being bounded by the veinlets. The spores are borne upon the under side of these patches and when mature are remarkably dark in color. This color is much darker upon the squash than the cucumber, and there are other differences which would be amply sufficient to warrant a varietal name if it was not evident from the hot-bed experiment that the differences are very probably entirely due to the influence of the host. During another season, should this pest return, it is hoped that other experiments will be made to determine more fully the habits of this fungus. As yet no oospores have been found. It should also be said that the attacks of this peronospora upon the cucumber were not confined to those growing under glass, but instead almost ruined some large fields of this plant. From the fact

that this fungus is closely related to the downy mildew of the grape it is safe to conclude that an occasional spraying of the vines with either the Bordeaux mixture or the ammoniacal solution of copper carbonate would prove an effective remedy. The only difficulty will be experienced in getting the liquid upon the under surface of the leaves, where it should lodge to be of most value. It remains to be seen whether the peronospora will attack and damage the water-melon, musk-melon, citron, and other cucurbitaceous plants related to the pumpkin, squash, and cucumber.

The potato rot (*Phytophthora infestans*, DBy.) has been unusually abundant in New Jersey, so much so that many large potato-growers have secured only a small fraction of a crop. The exceptional season has been a hard blow to the rot-proof theory that some "potato-seed" dealers have advanced. As far as observed there has been no one sort of potato that failed to be attacked when the conditions of moisture, warmth, etc., were most favorable. Apparently healthy potatoes secured from areas where most of the tubers have decayed show the threads of the fungus in the tissue, and especially in that portion in the vicinity of the eyes. Many farmers are still to be convinced that there is any danger in using such potatoes for the next season's planting.

In July some of the vines of *Ampelopsis veitchii*, commonly known as the Boston ivy, were found infested with a peronospora, that proved upon examination to be the *P. viticola*, DBy., so prevalent upon the cultivated grapes. Only a few plants out of many hundreds that are to be found in this vicinity were attacked, and all of these were young vines. In no case was any long petioled or divided leaf found with the mildew. The upper and exposed side of the infested leaves became prematurely bright-colored over the attacked portion; while beneath, the conidiphores were short, quite evenly set, and when the spores were mature the characteristic frosty appearance prevailed. It is evident that this is not a favorite host for the peronospora, and in ordinary seasons the vines will very likely not suffer from it. The native species of ampelopsis (*A. quinquefolia*) was often found near mildewed plants of the Boston ivy, but in no case was any of the fungus found upon this. It is, however, a well-known host.

The last peronospora of the season is that of the cultivated violet, (*V. odorata*), and was found upon leaves sent to the station by a grower of violets for the New York market, who claims that his crop is a failure and the loss is hundreds of dollars. A comparison of this peronospora was made with *P. violæ*, DBy., as found upon *Viola tricolor* var. *arvense* and distributed in Ellis' N. A. F. (No. 2207). The latter is placed among the species with dichotomous (uniformly forking into two parts) branching of the spore-bearing threads. In the form upon *V. odorata* there is no indication of this form, but instead it is quite like the mildew upon the grape in the manner of bearing the spores. Again, the spores of the two are different in size, shape, and color. It is true

that the size and color differences may be due to age, but in the *P. violæ* proper the spores are ellipsoidal, while in the other they are nearly perfect spheres. No oospores have yet been found. Whether it proves to be the same species or not, and that can be settled probably by cultures, the fact remains that one of our choicest of hot-bed plants is attacked by a mildew that from its destruction attracts the attention of the violet grower and should be treated with fungicides. A weak solution of the ammoniacal carbonate of copper would be likely to prove an effective remedy.

Among the species of cystopus, all of which have been abundant, only one need be mentioned here. The search, among students of this genus, for the oospores of *Cystopus ipomϾ-panduranæ*, Schw. (*C. Convolvulacearum*, Otth.) upon wild sweet potato, or Man-of-the-Earth (*Ipomœa pandurata*), a miserable weed with enormous roots, has been prolonged and was rewarded only recently, as stated by Dr. Farlow in *Botanical Gazette* for August, page 187. This fungus was abundant in some parts of the State this year, doing valiant work in helping to destroy a pest in cultivated grounds. In some cases the enlargements of the stem where the oospores are borne in great numbers were many times the normal size. The particular point, however, in mentioning the species here is to announce that the leaves were found distorted, and in these thickened points the oospores abound.

It may be said in closing, that strange distortions of the flower stalks of wild mustard were met with this season, which were due to the growth within of another member of the same genus as above mentioned. It also works striking modifications of the flowers and fruit of the cultivated radish, which are often observed by truckmen who let this plant go to seed.

PREVALENCE OF ERGOT IN 1889.

By Erwin F. Smith.

Claviceps purpurea, (Fr.) Tul. was unusually prevalent along the east shore of Lake Michigan in the summer of 1889. At South Haven and St. Joseph I saw it in every rye-field, and it was so abundant that it could be gathered by the handful. Even scattering patches of rye in orchards, meadows, and along roadsides were infected. The best developed sclerotia were two inches long, but where a half dozen or more grew from one head they were smaller. In that part of the country it has been customary for some years to grow rye in the peach orchards as a green manure. It is sown in the autumn and ploughed down in the spring, but some portion of the crop always escapes the plow and comes to maturity. Moreover, through neglect or for other reasons, the rye is not always turned under green, so that the soil may be

assumed to be infected by sclerotia each year. Another favoring condition was an unusually rainy season, April, May, and June being very wet.

The same month (July) I carefully examined a number of large rye-fields in the central part of the State, where the spring was also wet, but where rye is not commonly cultivated, nor ever twice in succession on the same field, the result being that I could not find a single sclerotium.

It would be interesting to know whether ergot was abundant in other parts of the country, particularly along the Atlantic coast, where the rainfall was very heavy, 1889 being one of the wettest seasons on record.

AN EXPERIMENT IN THE TREATMENT OF BLACK-ROT OF THE GRAPE.

By B. T. Galloway.

Despite the fact that black-rot has ravaged the vineyards of this country for more than a quarter of a century, no systematic attempt, aside from bagging the fruit, was made to combat it until within the past three years. It is true that numerous "remedies" were proposed for the disease, but in no case had any of them stood the test of a thorough trial.

Bagging the fruit as a means of preventing rot first began to be extensively practiced something like ten or a dozen years ago, and there is no doubt that when properly done it is still the safest and most trustworthy means of saving the fruit. The only drawback to bagging is the cost, which must necessarily be considerable, as each bunch, in order to be made secure, is first bagged, then the bag is fastened, and finally, when the fruit is gathered, the bags must be removed. All of this of course consumes time, and time is money in this case as well as in any other. Where a man has a few choice varieties that he wishes to preserve for table use it would probably pay him to bag the fruit; but if he is a large grower, using his crop for wine, the impracticability of such a plan will at once become apparent.

At the time bagging first began to be practiced, grape-growers, as a rule, recognized the fact that black-rot was a fungous disease, due to outside influences, and not brought about by any morbid conditions of the plant. At first it was the practice to put on the bags as soon as the first rot specks appeared; but experience soon demonstrated that to preserve the fruit it was necessary to inclose the clusters shortly after the flowers opened.

In order to settle definitely the cause of rot and if possible to provide a remedy, this Department began an investigation of the subject in 1886. It is not necessary here to go into the details of this work, it being sufficient for our purpose to say that it was proved beyond question that the malady was caused by a parasitic fungus growing within

the tissues of the berry, that this parasite was propagated by minute spores which were at all times present in the vineyard only awaiting suitable conditions of moisture and heat and contact with the growing fruit to cause infection. These facts once demonstrated it was readily understood why bagging prevented the rot, as by that process the spores were simply excluded and infection thereby made impossible. Having reached this stage of the investigation, the question arose as to whether there was not some substance or substances which if applied to the fruit would prevent the spores from germinating or destroy them entirely, thereby preventing infection in practically the same manner as with the bags.

The questions to be considered in this connection were numerous and difficult of solution. It was necessary that the substance employed should not injure the fruit or foliage, that it should be cheap, easily applied, and above all things practicable, and, finally, that it should not render the fruit unfit for eating or wine-making. The good results obtained in treating mildew with the sulphate of copper compounds was a sufficient reason for giving these preparations a thorough trial for black-rot. Accordingly the first systematic experiments, made with a view of determining the value of the copper remedies for the disease, were undertaken in the summer of 1887. The experiments were made over a very wide area, and, while the results were by no means conclusive, they were of such a nature as to warrant a further continuance of the treatment.

In 1888 the experiments were repeated on a more extended scale, and as a result it was demonstrated beyond question that in a favorable or even ordinary season from 40 to 60 per cent. of the crop could be saved from rot. These trials also showed that of all the preparations used the Bordeaux mixture, containing 6 pounds of sulphate of copper and 4 pounds of lime to 22 gallons of water, yielded the best results. It was further demonstrated that the applications to be successful must be applied *early;* in fact this was to be expected from what was already known concerning the proper time for bagging the fruit.

This year among other things we planned an experiment designed to throw some additional light on a number of questions in connection with the treatment of black-rot; chief among them were the following:

(1) A comparison of the actual cost and results of the treatment, using the preparations known as eau celeste, Bordeaux mixture, and the ammoniacal solution of carbonate of copper.

(2) The proper strengths of the preparations, i.e. the strength which would give the best results.

(3) The proper time to apply the remedies.

(4) The effect of winter treatment, *i. e.* spraying the vines before the leaves start.

The vineyard selected for the work was situated near Eastham, Va., and was the property of Mr. A. L. Holladay, who, it is proper to state,

conducted all the experiments from beginning to end. The vineyard, of about 2½ acres, contained something over 1,400 Norton vines, these being in their tenth year. This area was divided into sixteen sections; but as two of these were treated with remedies with which we are not at present concerned, they will be omitted altogether. The fourteen sections were treated as follows:

Section 1.—Bordeaux mixture *a*, containing 6 pounds of sulphate of copper and 4 pounds of lime to 22 gallons of water.

Section 2.—Eau celeste, containing 1 pound of sulphate of copper, 1½ pints of aqua ammonia, and 22 gallons of water.

Section 3.—No treatment.

Section 4.—Bordeaux mixture *b*, containing 4 pounds of sulphate of copper, 2 pounds of lime, and 22 gallons of water.

Section 5.—Eau celeste *b*, containing 2 pounds of sulphate of copper, 2 pounds of carbonate of soda, 1½ pints of aqua ammonia, and 22 gallons of water.

Section 6.—No treatment.

Section 7.—Ammoniacal solution of carbonate of copper, containing carbonate of copper 3 ounces, aqua ammonia 1 quart, water 22 gallons.

Section 8.—Bordeaux mixture *a*, applied in a different part of the vineyard from section 1.

Section 9.—No treatment.

Section 10.—Bordeaux mixture *b*, applied in a part of the vineyard remote from section 4.

Section 11.—Bordeaux mixture *a*, applied some distance from 1 and 8.

Section 12.—Bordeaux mixture *c*, containing copper two pounds, lime 1 pound, water 22 gallons.

Section 13.—Ammoniacal solution of carbonate of copper applied at some distance from section 7.

Section 14.—Bordeaux mixture *d*, containing 3 pounds of sulphate of copper, 1 pound of lime, and 22 gallons of water.

Sections 10 and 11.—Were treated in March with a simple solution of sulphate of copper, 1 pound of the copper to 25 gallons of water.

With the exception of 8 all the sections were sprayed the first time on May 18, the second on June 3, third on July 23, fourth on August 3, and fifth on August 16. Section 8 received its first application on the 6th of June, this being the experiment designed to test the effect of late spraying. On the 1st of October the fruit on all the sections was gathered and carefully weighed, with the following results:

Section.	No. of vines.	Total yield.	Average yield per vine.	Section.	No. of vines.	Total yield.	Average yield per vine.
		Pounds.	*Pounds.*			*Pounds.*	*Pounds.*
1	120	307¼	2.56	8	92	158¼	1.72
2	122	393¼	3.22	9	17	17	1
3	20	20	1	10	146	470	3.21
4	163	357¼	2.19	11	165	574	3.48
5	99	236¾	2.39	12	23	52	2.26
6	21	11¾	.56	13	108	159	1.48
7	108	159	1.48	14	114	336	2.94

Now, in regard to the cost, the chemicals were all purchased at wholesale rates, as follows:

Sulphate of copper	per pound..	$0.06¼
Best lime	per barrel..	1.25
Aqua ammonia	per pound..	0.05
Carbonate of copper, concentrated solution	per quart..	0.16⅔

Using the Japy pump and Vermorel nozzle, it is estimated that the cost of labor in applying the remedies was $2.50 per acre for five applications, or one-half a cent per vine. The number of gallons of the various solutions used per acre was, on an average, 44. Taking these figures as a basis, we have the total cost of treating the various sections as follows:

Section.	No. of vines.	Total cost of treatment.	Cost per vine.	Cost per acre.	Section.	No. of vines.	Total cost of treatment.	Cost per vine.	Cost per acre.
			Cents					*Cents*	
1	120	$1.61	1.3	$6.70	8	92	$1.23	1.3	$6.70
2	122	.95	.8	4.90	9	Proof.	......	......	......
3	Proof.	......	......	......	10	146	1.47	1.0	5.29
4	163	1.71	1.0	5.25	11	165	2.23	1.3	6.70
5	99	1.15	1.2	5.80	12	23	.17	.8	4.00
6	Proof.	......	......	......	13	108	.90	.8	4.00
7	108	.90	.8	4.00	14	114	1.04	.9	4.55

It is seen from the foregoing tables that the largest yield per vine (3.48 pounds) is in section 11, where the Bordeaux mixture, containing 6 pounds of copper and 4 pounds of lime, was used. This section also received the winter treatment. By comparing this yield with that of section 1, where the same mixture was used but the winter treatment omitted, it is seen that there is a gain in favor of the winter-treated section of nearly a pound per vine. Now examine the figures in section 4, treated with the Bordeaux mixture, containing 4 pounds of copper

sulphate and 2 pounds of lime, and it will be seen that the yield per vine is 2.19 pounds. In section 10, treated in exactly the same way, with the addition of one winter spraying with the simple solution of sulphate of copper, the yield is 3.21 pounds, a gain of more than a pound per vine. This certainly indicates that the winter treatment in this case resulted beneficially, but whether the same will hold true everywhere we are not prepared to say. Assuming that it does, however, let us, on the basis of the figures here given, estimate the cost of treating an acre of vines and compare the yield with that of an acre not treated.

Let us suppose that A owns a vineyard of 1 acre and that his neighbor, B, is the possessor of a similar number of vines of the same variety. A treats his vineyard six times, as follows:

March 20, sprayed with a simple solution of sulphate of copper, 1 pound to 25 gallons, at a total cost of 65 cents. May 18, June 7, July 23, August 5, and August 16, sprayed with the Bordeaux mixture, containing 6 pounds of sulphate of copper, 4 pounds of lime to 22 gallons of water, at a total cost of $6.70, which, upon adding the 65 cents for first spraying, becomes $7.35.

B makes no treatment whatever, consequently saves the $7.35. A's vineyard of 500 vines yields 3½ pounds per vine, or 1,750 pounds for the whole, which, at 3 cents per pound, equals $52.50.

B's vineyard yields 500 pounds, or 1 pound per vine, valued at 3 cents per pound, or, for the whole, $15. Summing up the results we have the following:

A.

By treatment of vineyard	$7.35
Yield of grapes, 1,750 pounds, at 3 cents per pound	52.50
Balance	45.15

B.

No treatment.	
Yield of grapes, 500 pounds, at 3 cents per pound	15.00
Difference in favor of A	30.15

Turning again to the table we notice that section 2, treated with eau celeste containing 1 pound of copper sulphate and 1½ pints of ammonia to 22 gallons of water, yielded 3.22 pounds per vine. This is indeed a very good showing, but as this preparation, unless used with extreme caution, is certain to burn the foliage its use can not be advised.

The conclusions which we draw from the foregoing may be briefly summed up as follows:

(1) It pays to treat the vines for black-rot.

(2) The best preventive, all things considered, is the Bordeaux mixture, containing 6 pounds of copper sulphate, 4 pounds of lime to 22 gallons of water.

(3) As the amount of copper in the Bordeaux mixture is decreased its value as a preventive is lessened.

(4) The application of the Bordeaux mixture should in all cases begin early, *i. e.*, about the time the flowers are opening.

(5) Spraying the vines before the leaves start with the simple solution of sulphate of copper is decidedly beneficial.*

ERYSIPHEÆ UPON PHYTOPTUS DISTORTIONS.

By F. W. ANDERSON and F. D. KELSEY.

Dr. Byron D. Halsted's note on *Sphærotheca* on Phytoptus distortions in the September Journal is interesting, and concludes by asking; "Have other Phytoptus growths been found infested with members of *Erysipheæ?*" So far as observations on the subject go in Montana an affirmative answer might be returned. In the article on Montana *Erysipheæ* in this number of the Journal by one of the writers, mention is made of *Sphærotheca Castagnei*, Lév. on *Shepherdia argentea* (Bull or Buffalo Berry), on *Geranium incisum*, and on *Erigeron Canadense;* also of *Sphærotheca mors-uvæ*, (Schw.) B. & C. on *Ribes rotundifolium;* the former fungus on *Shepherdia* and the latter fungus on *Ribes* were associated with the mites, and the peculiar powdery coating caused by these creatures in places almost covered the fungus. In both cases the distorted leaf axils, abnormally developed buds, and thickened brittle upper leaves bore the perithecia of largest size and in greatest numbers, leading us to the same natural conclusion as was formed in the mind of Dr. Halsted regarding the benefit received by the fungus through the unusual softening of the host tissues. Like him, too, we observed that on those portions of the host unaffected by the mite the fungus was only in an ordinary degree of development for that time of the year [July 10 for *S. Castagnei*, Lév., and June 8, or 9, for *S. mors-uvæ*, (Schw.) B. & C.]

On the *Geranium incisum* occurred also some mite together with the *S. Castagnei*, Lév., and again the fungus seemed to be more richly developed on the doubly affected parts. Late in the season the same fungus was found on *Erigeron Canadense*, and growing side by side with this host were plants of *Epilobium coloratum* badly affected by a mite, and the conidial form of an *Erysipheæ* which seemed to be *Sphærotheca Castagnei*, although no positive determination could be reached. On *Oxytropis Lamberti*, *Astragalus triphyllus*, and *Astragalus adsurgens*, *Erysiphe communis*, (Wallr.) Fr., has been frequently seen in company with a mite; while *Erysiphe cichoracearum*, DC., may be found at almost any time during the summer in connection with mites on *Chrysopsis villosa*, *Helianthus* (several species), *Cnicus undulatus*, *Erigeron macranthus*, and *Mertensia Sibirica*. In every case where these forms of animal

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*Applicable only to this experiment.

and vegetable life are so associated there is a more vigorous development and more early maturing of the fungus than under ordinary circumstances. Let us hear from others on this interesting subject.

TREATMENT OF APPLE SCAB.

By B. T. Galloway and E. A. Southworth.

In May of last spring arrangements were made with the experiment stations of Michigan and Wisconsin to carry on a series of experiments for the purpose of finding a remedy for Apple Scab (*Fusicladium dendriticum*, Fckl.).

The fields of experiment were located at Lansing, Mich., on the College Farm, and at Ithaca, Richland County, Wis.; the work at the former place being under the direction of Professor Taft, Horticulturist of the College and Experiment Station, and at the latter under the general supervision of Professor E. S. Goff, Horticulturist of the Wisconsin Experiment Station, and in direct charge of Mr. A. L. Hatch, of Ithaca.

The season was a favorable one, as the weather was wet enough to favor the growth of the fungus and thus offered a fair test of the remedies employed.

The plan of work was drawn up at this Department and the same outline for the experiments was given to both. The instructions were very carefully carried out, and both experimenters have been unremitting in their diligence in making the applications and preserving accurate accounts of the results.

The fungicides used were sulphide of potassium, hyposulphite of soda, a soluble sulphur powder prepared by Mr. E. Bean, Jacksonville, Fla., ammoniacal solution of copper carbonate, and modified eau celeste. Professor Goff, however, did not use the eau celeste.

Both made seven applications; Professor Goff beginning May 18, and Professor Taft May 24, when the apples were about the size of peas and before any trace of scab was apparent. In regard to the time of beginning, Mr. Hatch says he is convinced that the applications should be started earlier, as he thinks fungus activity begins with the swelling of the buds. The varieties treated were the Northern Spy, by Professor Taft, and the Fameuse, by Professor Goff; both selected because they had been particularly troubled by scab previous to the present year.

With regard to the strength of the solutions employed, Professor Taft and Professor Goff both used the potassium sulphide in the proportions of one-half ounce to the gallon of water. The hyposulphite was used in both cases at the rate of 1 pound to 10 gallons. Professor Goff records some injury to the leaves from this strength, and on the fifth applica-

tion Professor Taft reduced the solutions, using 1 pound to 12 gallons, after which he says there was no further injury to the foliage.

The soluble sulphur powder was used in the proportion of 1 pound to 10 gallons of water, but Professor Taft was not able to make the first application until June 6. Mr Bean also sent Professor Goff a concentrated solution of the powder, which was diluted and used for three applications to two trees, after which he was obliged to stop because he had exhausted the supply and received no more.

The copper carbonate was prepared differently by the two. Professor Taft used the usual formula, 3 ounces of copper carbonate dissolved in 1 quart of ammonia and the whole diluted to 22 gallons. It was used at this strength throughout the experiment, but produced a russet appearance on the fruit, and he recommends that it should be diluted to 28 instead of 22 gallons.

Professor Goff procured the copper carbonate by precipitating it with carbonate of soda from a solution of copper sulphate. He found that only $1\frac{1}{8}$ ounces of the dried precipitate would dissolve in 1 quart of ammonia, and to this he added 90 parts water. At the sixth spraying (July 24) he observed that the apples had assumed a russet appearance from some injury to the epidermis. For the sixth and seventh spraying he reduced it one-half, that is diluted it 180 times.

Professor Taft prepared the eau celeste as follows: He dissolved 2 pounds of copper sulphate in hot water, and in another vessel dissolved $2\frac{1}{2}$ pounds carbonate of soda; the two were mixed and diluted to 22 gallons, $1\frac{1}{2}$ pints of ammonia being added before using. This also gave a russet appearance to the fruit, and he recommends the use of 30 or 32 gallons of water instead of 22.

On the sixth application Professor Taft only sprayed one tree with each solution, leaving one unsprayed in each case. He made the last application August 1, and Mr. Hatch made the last application for Professor Goff on August 10.

Results.—The copper solutions remained persistently on the leaves, even resisting heavy showers which washed off all traces of the sulphur compounds, and when the leaves fell in October traces of copper could still be seen on them.

Scab was first noted at Lansing on the fourth application, June 25, when it had made its appearance on all the trees, but was noticeably less on those sprayed with the copper solutions, and less on the other treated trees than on the untreated ones.

At time of harvesting Professor Taft picked all the apples on the trees and assorted them into three lots, of first, second, and third quality. The first class contained those free from scab, the second those slightly scabby but not distorted or under size, the third those that were distorted or under size. Those in each class were counted and the percentage which they formed of the whole estimated.

At Ithaca, Wis., the apples were not all picked, but a market-basket

holding about 1½ pecks was first filled with apples from the lowest branches of one of the trees. Next a similar basketful was picked from the branches that were just the height one could conveniently reach, taking care to pass clear around the tree in both cases. After this a basket of one-half a bushel was filled from the tallest branches of the tree. The apples were then poured upon an assorting table; and the baskets filled and emptied again in the same manner and from the same tree, after which the contents of the six basketfuls were assorted into three qualities as in the preceding case.

The results in both cases are embodied in the following table:

	Professor Goff's experiments.					Professor Taft's experiments.					
	Applications.	Free from scab.	Slightly scabby.	Badly scabby.	Cost per tree.	Applications.	Free from scab.	Slightly scabby.	Badly scabby.	Cost per tree.	Total yield.
		Per cent.	*Per cent.*	*Per cent.*	*Cts.*		*Per cent.*	*Per cent.*	*Per cent.*	*Cts.*	*Pounds.*
Potassium sulphide	7	30.04	48.55	21.41	37	7	25.5	74.3	.2	39	1,615¼
Sodium hyposulphite	7	43.24	42.78	13.98	29	7	23.6	75.4	.89	23	1,648
Sulphur powder	7	32.72	54.31	12.97	31	6	17.6	81.2	1.1	31	1,435¼
Am'l copper carbonate	7	75.02	23.35	1.63	38	7	51.2	48.6	.16	49	2,112¾
Eau celeste	......	......	.....	....	......	7	68.8	31.0	.2	60	1,675¾
Sulphur solution	3	42.9	48.99	8.11	......	......	......	......	......	......	......
Unsprayed	......	23.34	53.89	22.71	......	......	12.5	85.7	1.8	.....	709¼

It will be seen that at both places there is a very decided showing in favor of the copper solutions. Professor Goff did not try the eau celeste, and this produced the best results for Professor Taft, giving 68.8 per cent. entirely free from scab. One of the trees produced 88 per cent. free from scab, the other was heavily loaded and gave 59 per cent. The two sets of results agree as to the main point but show some striking differences. It is probable that these are partly owing to different localities, varieties treated, and varying conditions of weather, and very likely in great measure to different ideas of the two experimenters as regards the three classes into which the apples were assorted. In many cases it would be a question as to which of two classes an apple should belong.

By comparing the two tables it is evident that the badly scabby apples were more numerous in Mr. Hatch's orchard, while those of the second quality preponderated on the college farm.

Professor Goff obtained the best results with the ammoniacal copper carbonate solution, thereby keeping 75.02 per cent. free from scab against 51.2 per cent. by Professor Taft. There is, however, about the same per cent. of badly scabby apples in both cases. Professor Goff's results with this are even better than Professor Taft's with eau celeste, except that the badly scabby apples were over 1 per cent. greater with the

former. The most striking difference in the results, however, is in case of the sulphur powder. With Professor Goff it ranked ahead of the potassium sulphide, and as regards amount of badly scabby apples, ahead of the sodium hyposulphite, while with Professor Taft it fell behind both. The solution of the powder which was prepared by Mr. Bean, although applied but three times, completely preserved 42.9 per cent. of the fruits from scab against 23.34 per cent. on the unsprayed trees, a very good showing under unfavorable conditions. With Professor Goff sodium hyposulphite succeeded better than potassium sulphide, while the contrary was true with Professor Taft, although the difference is not marked in either case.

Aside, however, from these minor differences, it is evident from the tables that the sprayed trees, especially those sprayed by copper compounds, produced a much larger percentage of healthy fruit than the unsprayed. The greatest difference between the perfect fruit on sprayed and unsprayed trees under Professor Goff's charge was 51.68 per cent. and the least 6.7 per cent. The greatest difference in those under Professor Taft's charge is 56.3 per cent. and the least 5.1 per cent., the two results being essentially the same.

Besides the tabulated results there were others which are of great importance but can not be estimated in exact figures. A scabby apple is much smaller than a healthy one, and in many cases, while the apples could not be placed in class one, the scab had so been held in check that the fruit had obtained a greater size than it otherwise would. Professor Taft gives the difference in weight between perfect and scabby fruits as varying from .037 to .002 pound for each apple, and says the scabby apples are 10 per cent. smaller than the perfect ones, making a difference of nearly a bushel per tree in size alone, besides the fact that the apples that are badly scabby are unmarketable. "From the combined effect of the two causes," he says "we lost on some trees a barrel of apples."

The cost of the chemicals and labor expended varied but slightly in the two cases, but both gentlemen were obliged to buy chemicals in small amounts, and the cost per tree would be greatly lessened by treating a large orchard and buying materials in quantity. Professor Taft used large trees requiring 3 gallons each for each application, while Professor Goff used 3 gallons for the two trees, but Professor Goff estimates the labor higher than Professor Taft, and this makes the figures nearly alike. Both these estimates, however, are for seven applications. In an average season, and with the copper solutions, four or at most five applications will probably be sufficient. It is likely that in a large orchard with average sized trees, when the chemicals were purchased by the quantity the expense could be reduced nearly one-half. The expense of the ammoniacal solution in particular would be reduced by purchasing the copper carbonate instead of preparing it from the sulphate.

In Mr. Goff's calculations the cost for labor in making the treatments amounts to more than half the expense.

It seems probable that it would be profitable to make the first application earlier than was done this year, and there is no reason why this application or the next should not be combined with London Purple or some other insecticide, and the tree protected from insects and fungi at the same time. Mr. Hatch closes his report thus:

What we now need is to determine the correct amount of the copper mixture to use, the times best suited to its application, and what combinations to make with insecticides, and a new era in fruit culture will be inaugurated.

NOTES.

By B. T. Galloway.

POWDERY MILDEW OF THE BEAN.

Under date of December 13 Mr. C. N. McCallan, of St. George's, Bermuda, writes that on the 20th of November his section was visited by a very heavy fog, and a few days later he noticed that his crop of six-weeks beans was badly mildewed, the fungus being one of the *Erysipheæ*, probably *Erysiphe communis*, Lév. He immediately gave the plants a thorough dusting with flowers of sulphur, and in a week the fungus had entirely disappeared and the plants produced a good crop. Mr. McCallan was highly pleased with this result, as he has several times lost his entire crop of beans from the attacks of the same fungus. In this country, peas, especially those planted late in the season, are often attacked by mildew, which in all probability might be easily prevented by the timely application of flowers of sulphur or some other fungicide. A powder made by mixing equal parts of air-slaked lime and flowers of sulphur will be found a very good remedy for this disease. The powder should be dusted on the foliage at the first appearance of mildew and the operation repeated every ten or twelve days, or more often if there is an abundance of rain.

If one has a spraying machine a solution made by dissolving 3 ounces of carbonate of copper in 2 quarts of aqua ammonia diluted to 22 gallons will be found an efficient remedy against mildew. This solution should be applied every twelve or fifteen days, beginning at the first appearance of the disease. Three ounces of carbonate of copper can be bought for 10 cents, while the ammonia will cost about 10, making the total cost of the 22 gallons 20 cents; certainly a very cheap fungicide. If carbonate of copper is not obtainable it may easily be prepared by first dissolving sulphate of copper (blue stone) in water and then adding ordinary washing soda. The precipitate formed on the addition of the latter substance is carbonate of copper, and in order to obtain it the liquid only needs to be drawn off and the copper carbonate dried.

RUST OF FLAX.

A short time ago we received from Mr. Frazier S. Crawford, of Adelaide, South Australia, some specimens of flax affected with a fungus, which upon examination proved to be *Melampsora lini*, (DC.) Tul. Mr. Crawford wrote that the parasite had destroyed a crop of flax near Adelaide, and expressed the fear that it would spread and prove a troublesome pest. The fungus has long been known in Europe, where it has occasioned considerable trouble; but so far as we are aware it has not been found on cultivated flax in this country. This seems rather strange considering the fact that it occurs here on quite a number of our native species of *Linum*; but after all an explanation of this may be found in the fact that the fungus is as yet confined to regions where there is little or no cultivated flax grown. We have it from this country on the following hosts:

Linum Virginicum, Decorah, Iowa (Holway).

Linum perenne, Sand Coule, Mont. (Anderson). Flagstaff, Ariz.; and Palisade, Nev. (Tracy).

Linum Lewisii, Spring Hill, Mont. (Anderson).

Linum rigidum, Livingston, Mont. (Seymour).

Linum sulcatum, Armstrong, Iowa (Cratty).

We see no reason why this fungus, if once introduced, would not prove a serious pest to our flax-growers, and until it is shown that it will not attack this crop it would be well to look upon it with suspicion. We have under way some experiments designed to throw some light on the question as to whether the fungus from western hosts will attack cultivated flax, but it is yet too early to speak definitely in regard to them.

NECESSITY FOR A REDESCRIPTION OF THE TYPE SPECIES IN KEW HERBARIUM.

In another part of the present JOURNAL will be found an interesting paper on some of Berkeley's types, by George Massee of the Royal Herbarium, Kew, England. There are over seven thousand type specimens of fungi in the Kew Herbarium, but every mycologist knows that in the majority of cases the descriptions of these are so meager and the figures so inaccurate that it is absolutely impossible to use them in the determination of species. As a result species and even genera are constantly being redescribed as new, thereby adding to the confusion which already exists.

To avoid further trouble of this kind, and at the same time to preserve to the world the valuable material, which however well cared for will eventually through the ravages of time become worthless, it seems to us of the highest importance that the types should be described anew from our present stand-point of knowledge. Such a work, accompanied by good illustrations, would be of untold value to mycologists

everywhere, and we feel sure that we voice the sentiment of all workers in this field when we say that the Kew authorities could not render a better and more highly appreciated service than the carrying out of such an undertaking.

NEW LOCALITIES FOR PERONOSPORA CUBENSIS, B. & C.

In the *Botanical Gazette* for August, 1889, and on page 201 of the present JOURNAL, attention is called to this fungus, the localities for its occurrence being given as Cuba, Japan, and New Jersey. We have recently received it from Anona, Fla., and College Station, Tex. At the former place, according to our correspondent, it appeared in the early part of December and destroyed a large number of cucumber plants growing in the open air in a few days. At College Station it also occurred upon *Cucumis sativa*, but no account of the injury it occasioned was furnished. That it was abundant there, however, is evident from the fact that our correspondent sent us more than 150 good specimens and did not seem to have any trouble in getting them.

REVIEWS OF RECENT LITERATURE.

BEUCKER, GEORGES. *Traitement du Mildiou.* Le Progrès Agricole, 4 août 1889; *ibid.*, 1er septembre 1889.

These short reports coming from the French School of Agriculture recommend strongly to the use of viticulturists a fungicide which has hitherto not been used to any great extent in this country—verdigris, or basic copper acetate. In an experiment extending over three years this fungicide has proved to be, taking all its features into consideration, the most satisfactory among the copper compounds. The chemical itself being a mixture of the normal and bibasic acetates of copper is decomposed by the action of water, and the insoluble bibasic salt precipitated as a light jelly-like substance, which upon being sprayed upon the leaves dries and covers them with a hard horny layer. It is claimed for this solution, made by adding to 6 or 8 gallons of water at the ordinary temperature 2 to 4 pounds of the powdered verdigris and allowing it to stand twenty-four hours before diluting to 22 gallons, that it possesses in a much higher degree than the Bordeaux mixture the quality of adhesiveness, while lacking none of the latter's qualities as a preventive of mildew.

In the report of September the author answers many questions brought out by the former report of August in regard to the nature of the chemical and its proper application, giving in some detail a method for the home production of the basic acetate from the waste *marc*, or pumice of the grape, and small copper plates. The cost of the material is also carefully worked out, calculation being made for labor of

preparation by the home process. The conclusion reached shows a cost of only $2.25 per acre when the verdigris is of home manufacture. The question of danger in its use is answered by reference to analyses made of grapes sprayed with the mixture, showing only an infinitesimal quantity present in the wine, and also to the medical works of Dr. Pécholier and Saint Pierre, which go so far as to say that when taken in small doses the acetate has a decidedly beneficial influence upon the human system.

From the inexpensiveness of the material, 20 to 30 cents per pound, when it is remembered that only 5 to 6 pounds are sufficient to spray one acre, the ease with which it may be prepared and applied and its decided efficiency, evinced by such a series of experiments as are contained in these reports of Mr. George Beucker, it seems worthy at least of a thorough trial among the vineyards of this country.—DAVID G. FAIRCHILD.

DIETEL, DR. PAUL. *Ueber Rostpilze, deren Teleutosporen kurz nach ihrer Reife keimen.* Botanisches Centralblatt, 1889, Nos. 18–20.

Dr. Dietel attacks the well-known Lepto and Micro sections of the genera of the *Uredineæ* and says no such division can be made either on a morphological or biological basis. He cites examples of species belonging to other sections whose teleutospores also germinate immediately after ripening. He recommends instead of the Lepto and Micro sections one section whose distinguishing character should be the formation of teleutospores unaccompanied by any other form, and that this should have two subsections with the same distinguishing characters that now mark the two main ones.

The species belonging to the Lepto-section of the *Uredineæ* are discussed according to their hosts, and in many cases the union of species generally considered as distinct is suggested; among these suggestions are the following:

Puccinia malvastri, Pk., is undoubtedly identical with *P. sherardiana*, Korn., and the latter name, being the older, should be adopted. The group of *Uromyces* attacking the *Malvaceæ* should probably be much reduced in number, but at least one true *Lepto-uromyces* must exist.

Puccinia mesnieriana, Thum. on *Rhamnus alaternus* in Portugal is identical with *P. digitata* on *R. croceus* from California.

P. saxifragæ, Schlectd., *P. curtipes*, Howe, and *P. striata*, Cke., are probably identical, and *P. saxifragæ* is a *Lepto-puccinia*.

P. chrysosplenii, Grev., *P. spreta*, Pk., and *P. congregata*, E. & H. differ only in minor points, so that it is impossible to consider these species with which *P. tiarellæ*, B. & C., and *P. heucheræ*, Sch., should probably be included as strongly distinct from each other.

He considers *P. asteris* as the type of *Puccinia* on *Compositæ* and notes the following as agreeing with it more or less perfectly: *P. vomica*, *P. serratulæ*, *P. subtecta*, *P. Printziæ*, *P. gerardii*, *P. xanthii*, *P. silphii*, and *P. grindeliæ*.

Conclusions.—The presence of *Uredineæ*, whose teleutospores germinate immediately after ripening, is not confined to certain families of Phanerogams, the *Liliaceæ*, *Gramineæ*, *Cyperaceæ*, and *Umbelliferæ* being the only families not represented among their hosts. Their presence does not seem to depend simply on the presence of host plants, but to be correlated with meteorological conditions. They are more abundant in high mountains and moist valleys, or on low land by rivers.—EFFIE A. SOUTHWORTH.

KELLERMAN AND SWINGLE. *Preliminary Report on Smut in Oats.* Bulletin 8. Experiment Station, Kansas State Agricultural College, 1889.

There has long been no doubt that wheat may be infected with smut by dusting the grain with spores, or by sowing it in soil in which the spores already exist. Consequently since the spores can pass uninjured through the intestines of cattle, it becomes a dangerous matter to use manure from stock that have had access to straw of smutted wheat. Since this is true for wheat, the natural inference is that it is also true for oats and barley. This has been questioned, however, and in 1888 in an article, already reviewed in this JOURNAL, Mr. J. L. Jensen gave very conclusive proof that grains still included in the husks at the time of planting could not be infected by spores which came in contact merely with the exterior of the husks, and consequently that spores in the manure or in the soil could have no effect on the amount of smut in the crop.

In the Bulletin above mentioned Professor Kellerman and his assistant, Mr. W. T. Swingle, give a full account of further conclusive experiments in the same direction. They have also included in their experiments a comparison of the value of sulphur and iron compounds against hot water as a dressing for seed grain.

An experiment to artificially infect oats when in blossom failed, but other experiments clearly established that the spores must be in or sticking to the seed when planted. Experiments in planting seed treated in different ways in untreated soil and soil which had been artificially manured, or smutted, or both, gave the following results: Soaking the seed in a solution of iron sulphate ($1\frac{1}{2}$ pounds per gallon) did not materially decrease the amount of smut or injure the grain; soaking the seed in copper sulphate solution (4 ounces to 1 gallon) eighteen hours prevented smut but lessened the fertility of the seed; treating seed with hot water (132° F.) for fifteen minutes prevented smut and improved rather than diminished the germinating powers of the seed and vigor of the plants; soil which had been treated with manure and smut the previous August actually gave a less per cent. of smut than untreated soil; soaking the seed eighteen hours in a 5 per cent. solution of concentrated lye prevented smut, but injured the seed; soaking eighteen hours in a 3 per cent. solution of sulphuric acid did not pre-

vent smut, while a 10 per cent. solution prevented smut and greatly injured the seed.

Natural enemies of smut.—Five different natural enemies of smut are described. A white mold, probably some species of *Fusarium*; a black mold, a new species of *Macrosporium*; a bacterial disease; and two smut-eating beetles.

The bulletin also contains a few preliminary notes on stinking smut, announcing that experiments are already under way to determine the comparative value of different fungicides in this case also.—EFFIE A. SOUTHWORTH.

KELSEY, F. D. *Study of Montana Erysipheæ.* Botanical Gazette, Vol. XIV. No. 11, p. 285.

This paper, prepared by Mr. Kelsey, contains a number of interesting notes upon nine species of *Erysipheæ* of Montana, a number of rare hosts being cited, and one provisional new species, *Erysiphe sepulta*, E. & E. on *Bigelovia graveolens*. This species is, however, acknowledged to resemble *E. chicoracearum*, DC. quite closely, a species widely variable upon the many hosts which it inhabits.—DAVID G. FAIRCHILD.

L'ECLUSE, A. DE. *Traitement du Black Rot.* Rapport à M. le Ministre de l'Agriculture. Le Progrès Agricole, October 13, 1889.

The results contained in this short report to the French minister of agriculture, while they present nothing strikingly new in the matter of treatment of black-rot, may be of interest to vine-growers and others as coming from a foreign experimenter. The author theorizes in the first part of the report among other things upon the ability of the fungicidal solutions to penetrate the conceptacles of the black-rot upon the leaves, taking it for granted that the leaf-spot and black-rot of the berries are identical. He believes it consequently almost useless to spray the berries simply without destroying the sources of infection found in the fungus of the leaves, and counsels spraying all the green surfaces of the vine as well as the grape clusters themselves. This to be done at least before the middle of May.

The report of the author's field experiments, in which the common fungicides seem to have been largely used, contains no new points either in matter of apparatus or mixtures, and is somewhat complicated, certain unexpected variations being explained by the ungovernable conditions so abundant in such work. Without discussing the details of the investigations or questioning particularly whether he is authorized in drawing such broad conclusions from only one year's experiments, it may be well to state briefly the author's opinions: That the efficacy of the copper compounds against black-rot is indisputable; that the disrepute into which they have fallen is due solely to misdirected use of them; that their action is at the same time preventive and curative if spread uniformly upon all green parts of the vine; and that the crop

gathered will be lighter as the applications are less perfectly made. In conclusion the writer adds:

I am happy to be able to say that the black-rot, which American viticulturists have considered with reason as the worst of diseases, is to-day a malady less difficult to guard against than the odium, the anthracnose, or the mildew.—DAVID G. FAIRCHILD.

PECK, CHARLES H. *Boleti of the United States.* Bulletin of the New York State Museum, Vol. II, No. 8, September, 1889.

In this bulletin Professor Peck brings together descriptions of all *Boleti* known to occur in the United States. Convenient synoptical tables have been arranged for the use of students, and the author seems to have done everything to make this a complete synopsis of the United States species of this important family. Western readers will at once notice that the Rocky Mountain regions are not cited in the geographical distribution of the species, and even California is only credited with a very few, the vast majority seeming to occur in the Eastern and Southern States. We would naturally inquire whether the *Boleti* have been carefully searched for by botanists in the Rockies, or whether there is a natural but deplorable dearth of such fungi in these regions. It is almost certain that from the western slopes of the Rocky Mountains many new and otherwise interesting *Boleti* will yet be reported, because on the western slopes the best natural conditions obtain for their development. It is possible, however, that the comparative lack of damp forests and copses on the eastern slopes, of the northern Rockies at least, may preclude the possibility of very many *Boleti* ever being found there, as the forests, though extensive, are neither very dense nor very humid.

In the paper before us 110 species are recorded, as against 100 species described in *Hymenomycetes Europæi.* Of the whole number 36 are natives of Europe as well as America. The author has found it necessary to establish two tribes not represented in European *Boleti*, as he remarks, "for the reception of species for which no place is found among the Friesian tribes." He has adopted Fries's classification in the main. He tells us that a few species have been left unclassified in consequence of the imperfect character of their descriptions, and that a few unpublished species have been omitted because they are as yet represented by too scanty material. The genera included in the paper are as follows: BOLETINUS—5 species. This genus is distinguished from *Boletus* by the tubes not being easily separated from the hymenophore and by the hymenium having a perceptibly radiating structure. BOLETUS—103 species; the six following being described as new: *B.* (*Viscipellis*) *hirtellus; B.* (*Subpruinosi*) *dictyocephalus; B.* (*Calopodes*) *rimosellus; B.* (*Calopodes*) *flexuosipes; B.* (*Edules*) *leprosus; B.* (*Luridi*) *subvelutipes.* STROBILOMYCES—2 species. This genus is distinguished from *Boletus* by the tubes being not easily separable from the hymenophore and by the hymenium being without a perceptibly radiating structure. The author remarks that by the former character and by the tough sub-

stance the transition between *Boletus* and *Polyporus* is made. Out of the 110 described, 18 species and 2 varieties are recorded as edible; but of these the three we have marked by Roman type are regarded with suspicion. The edible species are as follows:

Boletus elegans, Schum.; *B. Clintonianus*, Pk.; *B. luteus*, L.; B. granulatus, L.; *B. Collinitus*, Fr.; *B. badius*, Fr.; *B. bovinus*, L.; *B. rubinellus*, Pk.; *B. miniato-olivaceus*, Frost.; *B. miniato-olivaceus*, var. *sensibilis*, Pk.; B. chrysenteron, Fr.; *B. subtomentosus*, L.; *B. edulis*, Bull.; *B. æstivalis*, *B. impolitus*, Fr.; B. versipellis, Fr. *B. scaber*, Fr.; *B. castaneus*, Bull.; *Strobilomyces strobilaceus*, Berk.

Students will not find many *Boleti*, any more than any other kinds of fleshy fungi, during a dry season or during the dry part of any season. They are a moist, fleshy group of plants, and only thrive well where there is plenty of atmospheric humidity. Professor Peck's experience has been that a few common species of *Boleti* may be found from June to October, but that most of them occur only in July and August, the warmest part of the season, and that they are most abundant of all in very warm showery weather.

It was a happy thought which induced the author to prepare this useful monograph; and let us hope that its publication will serve as a stimulus to Rocky Mountain and Pacific coast botanists in the study of the *Boleti* of this vast and too-much neglected region.—F. W. ANDERSON and F. D. KELSEY.

THAXTER, ROLAND. *A New American Phytophthora.* Botanical Gazette, Vol. XIV, No. 11, p. 273.

Dr. Thaxter's note in the last *Gazette* will be of interest to all who know the peculiarities of this somewhat isolated genus. This new species of *Phytophthora* was found in the vicinity of New Haven, Conn., growing upon and destroying large quantities of lima beans. The pods, both young and old, seem to be best suited to the growth of the fungus, upon which it appears as a "clear white felted coating," partly or entirely covering both sides of the pods. Like its near relative, it seems to be a rapid disorganizer, soon opening the way for numerous saprophytic forms. It differs from *P. infestans*, DBy., in its larger and proportionately broader conidia, and the distinct appearance and mode of branching of the conidiophores. In its large size it seems to resemble the *P. cactorum* of Europe, but Dr. Thaxter, although not able to examine specimens of the latter, has decided that it differs specifically from the European species. He has accordingly named it *Phytophthora phaseoli*, n. s., and adds a concise description, which it may be well to repeat:

Mycelial hyphæ branched, rarely penetrating the cells of the host by irregular haustoria. Conidiophores slightly swollen at their point of exit through the stomata, arising singly or one to several in a cluster; simple or once dichotomously branched and once to several times successively inflated below their apices. Conidia oval or

elliptical, with truncate base and papillate apex; 35–50 by 20–24 μ. Germination by zoospores, usually fifteen in number, or rarely by a simple hypha of germination. Oospores unknown. On pods and stems of the lima bean (*Phaseolus lunatus*), New Haven, Conn., September and October.—DAVID G. FAIRCHILD.

THÜMEN, FELIX VON. *Die Pilze des Aprikosenbaumes* (*Armeniaca vulgaris*, Lam.). *Eine Monographie.* Klosterneuburg bei Wien. Verlag der k. k. Versuchs-Station. October, 1888. Small quarto. Paper. pp. 19.

The importance of the apricot industry in some parts of the United States, particularly in California, where there are very extensive orchards, makes this paper of considerable interest to fruit growers.

According to Professor von Thümen the apricot possesses no great longevity, but yields good fruit abundantly and can be grown satisfactorily even upon an inferior sandy soil. Early bearing partly compensates for its brief existence, and but for the number of diseases to which it is subject it would be much more generally cultivated. The author describes twenty-seven fungi which have been found on this tree either as parasites or saprophytes as follows, the former in Italics the latter in Roman type.

ON THE FRUIT.—*Phyllosticta vindobonensis*, Thüm.; *Phoma Armeniacæ*, Thüm.; *Monilia fructigena*, Pers.; *Monilia laxa*, Sacc. & Vogl.; *Glæosporium læticolor*, Berk.; *Epochnium virescens*, Mart.; Sporotrichum lyococcon, Ehrenbg.; Melanomma Minervæ, H. Fab.

ON THE LEAVES.—*Puccinia prunorum* Lk.; *Podosphæra tridactyla*, DBy.; *Capnodium armeniacæ*, Thüm.; *Phyllosticta circumcissa*, Cooke.; *Clasterosporium amygdalearum*, Sacc.; Cladosporium herbarum, Lk.

ON THE BRANCHES AND TWIGS.—Valsa ambiens, Fr.; Valsa cincta, Fr.; Valsa leucostoma, Fr.; Eutypella prunastri, Sacc.; Cenangium prunastri, Fr.; Diplodia pruni, Fuck.; Diplodia amygdali, Cooke & Hark.; Cytispora leucostoma, Sacc. (gonidia of Valsa.); Cytispora cincta, Sacc. (gonidia of Valsa.); Cytispora rubescens, Fr.; *Coryneum Beijerinckii*, Ouds.; Melanconium fusiforme, Sacc.; Hymenula armeniacæ, Schulz & Sacc.

Some of the so-called saprophytic forms may be parasitic. Most of the species occur on other plants. Those peculiar to the apricot are *Phyllosticta vindobonensis*, *P. circumcissa*, *Phoma armeniacæ*, *Epochnium virescens*, *Capnodium armeniacæ*, *Melanconium fusiforme*, and *Hymenula armeniacæ*. It will also be observed that many of these fungi, especially the parasites, are imperfect forms, whose life history remains to be worked out.

The brief Latin description which introduces each species is followed by paragraphs on the characteristics of the disease, its distribution, and other matters of interest, including treatment for the parasites in the few cases where any has been discovered. From these notes it appears that the European *Podosphæra tridactyla* also affects damsons, prunes, and plums, especially the first, but has not been found upon the cherry, although in this country it is common upon the latter. *Monilia laxa* is generally confounded with *M. fructigena*. It

occurs only on plums, prunes and apricots. *Capnodium armeniacæ* is described solely from mycelium and gonidia. *Phyllosticta circumcissa* and *Clasterosporium amygdalearum* make "shot holes" in the leaves. Both are serious evils, the *Phyllosticta* being specially prevalent in the orchards of South Australia. The use of the term perithecia for receptacles containing only gonidia is not to be commended.—ERWIN F. SMITH.

VIALA, PIERRE. *Une Mission Viticole en Amerique.* Published at Montpellier, No. 5 Grand Street, by C. Coulet, and at Paris, No. 120 Boulevard St. Germain, by G. Masson. 1889.

This work (387 pages), illustrated by eight chromo-lithographs and a geologic map of the United States, contains the observations upon American grape-vines and their maladies, made by Professor Viala during a tour through the United States in 1887. By the French Government Professor Viala was commissioned to inspect the grape-vines, native of America, which might be found growing in marly or calcareous soils, with the view of finding a species of vine adaptable to culture on similar soils in France. In the preface to his book Professor Viala states that it "is not a report of his work upon this viticultural mission, but rather a study, complete as possible, of all the questions relative to American grape-vines and to the maladies of the vine in the country of their origin." With such a scope, the studies of this distinguished botanist will be of important interest to botanists and viticulturists of America as of Europe. In his extended tour throughout the United States Professor Viala was aided by our Government, and accompanied officially by Prof. F. Lamson Scribner, then Chief of the Section of Vegetable Pathology, United States Department of Agriculture, and now of the Agricultural Experiment Station, Knoxville, Tenn. According to Viala, there are of American vines eighteen known species. In the other parts of the earth there are but twelve; one species in Europe; the others in Asia. *Vitis vinifera* is indigenous to Europe. Of our native vines, those of interest to French viticulture, either as fruit-bearers or as graft-bearers, for the viniferas, are *Vitis Berlandieri*, *V. cordifolia*, *V. rupestris*, *V. riparia*, and sundry varieties of these species.

Of our long list of cultivated varieties but few find favor with Viala, being generally stigmatized as "*foxy*." This, however, is a matter of national taste. Wines which Frenchmen condemn are approved by Americans and Germans; while Frenchmen long resident with us learn by habitude to prefer the high-flavored American wines. The day may come when the "*peculiar*" flavor of the *Labrusca* and of the *Riparia* may be esteemed as a commendation. "*De gustibus non disputandum.*"

Part second of Viala's volume is devoted to an exhaustive study of "the maladies of the vine in America"—black rot, white rot, bitter rot,

anthracnose, oidium, and other fungi, together with suggestions for their treatment; also a formidable list of insect enemies to the vine and its fruits; and an appendix treating of the adaptation of American vines to soils.

Altogether this work of the distinguished botanist is of standard interest, and in its preface we have the assurance that it will be soon followed by a second volume, wherein Viala will record personal observations made in travel through our country, and also "Studies upon Viticulture and Vinification in the United States." The volume under consideration is of especial interest to scientists; the volume to come will surely be instructive to the practical student of viticulture and viniculture.—A. W. PEARSON.

WAKKER, J. H. Contributions a la pathologie végétale: (1) *La morve des Anémones, produite par le Peziza tuberosa*, Bull.; (2) *Nouvelle recherches sur la gommose des Jacinthes et plantes analogues*; (3) *Les renflements des branches de quelques espèces de Ribes*; reprint from *Archives Néerlandaises*, Tome XXIII, p. 373–400, with 2 plates on Gummosis.

(I.) The author completes some observations on a disease of anemones known as black rot, and due to *Peziza tuberosa*. This fungus occurs principally on *Anemone Coronaria*, its varieties and hybrids, these being the sorts most frequently planted. It has also been observed on *A. ranunculoides* and *A. nemorosa*.

The symptoms of the disease are essentially the same in all the species. The leaves turn brown, wither early, and pull up very readily. The root-stock is the part first attacked and the chief seat of the disease, but the base of the petioles may also become involved. In a normal condition the interior of the root-stock shows the milk-white color of ordinary starch-bearing parenchyma, but under the influence of this fungus it assumes a gray tint, and becomes soft and easy to crush between the fingers. Large mycelial filaments penetrate this soft mass in all directions, passing between the cells and through them. These filaments were traced into the firm tissues of the rhizome. There their very blunt extremities are found only between the cells, the filaments, as in many other cases, growing around and between the cells before determining their destruction.

When the diseased plants are left undisturbed in the earth, the mycelium produces large sclerotia, easily mistaken for the root-stocks of *A. coronaria*, a fact which singularly favors the spread of the fungus.

Toward the end of April these sclerotia begin to produce the ordinary *Peziza* cups. These are a uniform milk and chocolate color, 55 mm long; 3 mm thick; with a disk breadth of 15 mm. Some other measurements are: asci, 190 x 12 μ.; paraphyses, 190 x 2 μ.; spores, 16 x 8 μ. For admirable figures of the *Peziza* form, see Tulasne *S. F. C.* III, Tab. 22, Figs. 1–5.

In the ascus, or in water, the spores send out long tubes within 24 hours, and produce sporidia in 48 hours, after which they perish. These sporidia occur in great numbers (see also Brefeld, IV., Pl. IX, Fig. 16–19), but are functionless. The case is otherwise on nutrient media. The author used a decoction of raisins, solidified by the addition of gelatine and sterilized by discontinuous heat. This substratum is easy to prepare and very suitable for the development of mucedineous facultative parasites. By germinating the ascospores on slides in drops of this gelatine and transferring the mycelium after four days to Van Tieghem cells, the bottoms of which were covered with gelatine, he obtained a most luxuriant growth, but no sclerotia during the whole life of the mycelium, which exceeded three months.

This fungus needs a start before it is strong enough to attack healthy tissues. Infection takes place by means of the mycelium, and hence, except in rare cases, it is possible only through the parts underground. Ascospores sown on fresh cuts of different rhizomes gave no results; but two rhizomes taken from the same pot were quickly infected (in four days) and destroyed with the usual symptoms, by bringing them into contact with some mycelium taken from one of the cell cultures. When the spores find their way into the soil, especially when they lodge on the posterior decaying end of the rhizone, they are undoubtedly in a condition favorable to robust growth, and have an excellent opportunity to attack the plant.

Dr. Wakker discusses the relation of *P. tuberosa* to *P. bulborum*, which attacks hyacinths and related *Liliaceæ* in the same locality. The chief difference lies in the size of most of the organs, those of *P. bulborum* being smaller. The spore measurements, however, are identical, so that he would be inclined to doubt the specific difference were not the conviction universal among horticulturists that the disease never passes from hyacinths to anemones, or inversely.

The ascus form is common in *P. tuberosa*. In the hyacinth disease, and other sclerotial diseases, the *Peziza* cups rarely develop. For this reason, and others, the author inclines to believe that *P. tuberosa* is the species truly indigenous to Central Europe and that *P. sclerotiorum* and *P. bulborum* are derivatives from this original stock, changed conditions having produced slight modifications, forming distinct but very closely related species.

(II.) The author is able to throw some additional light on the gummosis of the hyacinth. He has also discovered gummosis in the tulip and in *Tecophilea cyanocrocus*. A similar degeneration also occurs in *Ixia* bulbs (Dr. Masters) and in *Cyclamen* leaves (Prillieux).

The very small gum pockets in the substance of the inner scales of the hyacinth are pure white, and their walls are still composed of living cells. These pockets are not limited, however, to the youngest scales, but invade even the outermost tunics and are often large, the walls becoming dead and structureless and the gum exuding on the surface of

the bulb in small drops. These superficial drops frequently contain mycelium, but, as in previous examinations, none could be found in any of the closed pockets, even by the most approved and delicate methods of section cutting and staining. A similar examination of tulip bulbs led to the same result. There is also no ground for belief that gummosis is due to the attacks of *Tylenchus*. Although Beyerinck found gummosis to be communicable in the *Amygdaleæ*, the author so far has not been able to produce it artificially in hyacinths. The moistened gum did not increase in quantity, or cause any gummy degeneration of surrounding tissues when put into wounds or on the cut surface of bulbs. From two experiments in which bulbs were kept for a long time in moist earth at a high temperature (30° to 37° C.), and from considerations published elsewhere, the author concludes that the stinking white rot of the bulbs is always preceded by gummosis. In conclusion he says:

The little we know to-day on the subject of gum formation in bulbous plants may be summarized as follows:

(1) The gum is found essentially either between the parenchyma cells of the scales or else between the epidermis and the parenchyma.

(2) In the vicinity of a gum pocket the starch disappears from the parenchyma cells and is replaced by gum.

(3) Those cells totally deprived of starch are not only completely alive, but may increase much in size and even divide tangentially.

(4) In the cells which have died prematurely the starch remains unchanged.

(5) Lining the greater part of the wall of cells, which surrounds the cavity, is a layer of gum of greater density (as shown by its yellow color) than that which occupies the center of the cavity.

(6) Gummosis and the white rot are one and the same disease.

(7) Of a parasitic cause there is no trace.

(III.) The author describes what he calls a *rhizomania* in species of Ribes, *i. e.*, a tendency in the branches to the formation of numerous, incipient, adventitious roots. These abnormal roots either do not pierce the bark or dry up and die as soon as they have done so, leaving only slight conical prominences. The result of these numerous growths is a hypertrophy and degeneration of various tissues, especially of the bark, with the formation of black or brown, rough and irregular, roundish or elongated tumors, having a diameter many times greater than that of the normal branch. Main stems, robust vertical branches, and shoots of the first year show no trace of these tumors, and where only a single root was formed the author observed no pathologic change.

These growths differ from the ordinary production of roots on branches in the following particulars: (1) The disposition of the roots appears to be entirely independent of the force of gravity or the direction of the light. (2) These roots also differ essentially in that their production is not restricted but goes on indefinitely to the formation of tumors. The author has been able to find in literature no mention of any analogous fact. In some respects the growths suggest "witch brooms," but the author could find no traces of any animal or vegetable parasite.—ERWIN F. SMITH.

ZACHAREWICZ, ED. *Traitement de la Maladie des Pommes de Terre, des Tomates et des Melons, par les Sels de Cuivre.* Le Progrès Agricole et Viticole, 14 Juillet, 1889.

The author gives in this brief note a few points of practical value in the treatment of potato and tomato rot, *Phytophthora infestans*, DBy., especially as testing the efficacy of the eau celeste and sulphosteatite, a mixture of one part of powdered copper sulphate to nine of talc, "it being well known that alternate treatments of Bordeaux mixture and this powder have proved generally successful."

For the purpose of experimentation three lots of tomato vines were taken. The plants of the first were grown in hot beds upon trellises and carefully guarded against rapid changes of temperature by raising and lowering the sashes. Those of the second and third lots were grown without any trellises in the open air, exposed to natural conditions. In the first set, guarded from the heavy dews, present in that locality in the month of June, only three sprayings with eau celeste given at intervals of fifteen days, preserved the plants perfectly from the disease. The second, exposed to ordinary climatic conditions, was sprayed upon May 8, and 28, and June 18, with eau celeste, and dusted May 20, June 8, and 26, with the mixture of copper sulphate and talc. By this treatment the disease, which appeared first May 26, was stopped and the fruits completely preserved, while a number of plants to one side, left unsprayed, lost by June 10, not only their leaves, but the greater part of their fruit. The third set, which differed from the second only in that all six sprayings, made about the same time, were with eau celeste, failed to give as satisfactory results, at least one-third of the fruits being destroyed by the rot. This difference in favor of the second lot the author thinks is due to the alternate use of the copper solution and the sulphosteatite, and draws the following conclusions from his experiments: That, the malady having its seat in the organs of the plant, all successful treatment must be preventive, consequently commenced before transplanting and continued at intervals of fifteen to twenty days, care being taken to treat in the intervals with sulphosteatite; that it is best not to modify the formula for eau celeste given by Mr. Audoynaud—1 pound of sulphate of copper in 2 gallons of water and 1½ pints of ammonia, diluted with 22 gallons of water when cool; and that the sulphosteatite should be applied at the rate of 14½ pounds to the acre, preferably early in the morning.—DAVID G. FAIRCHILD.

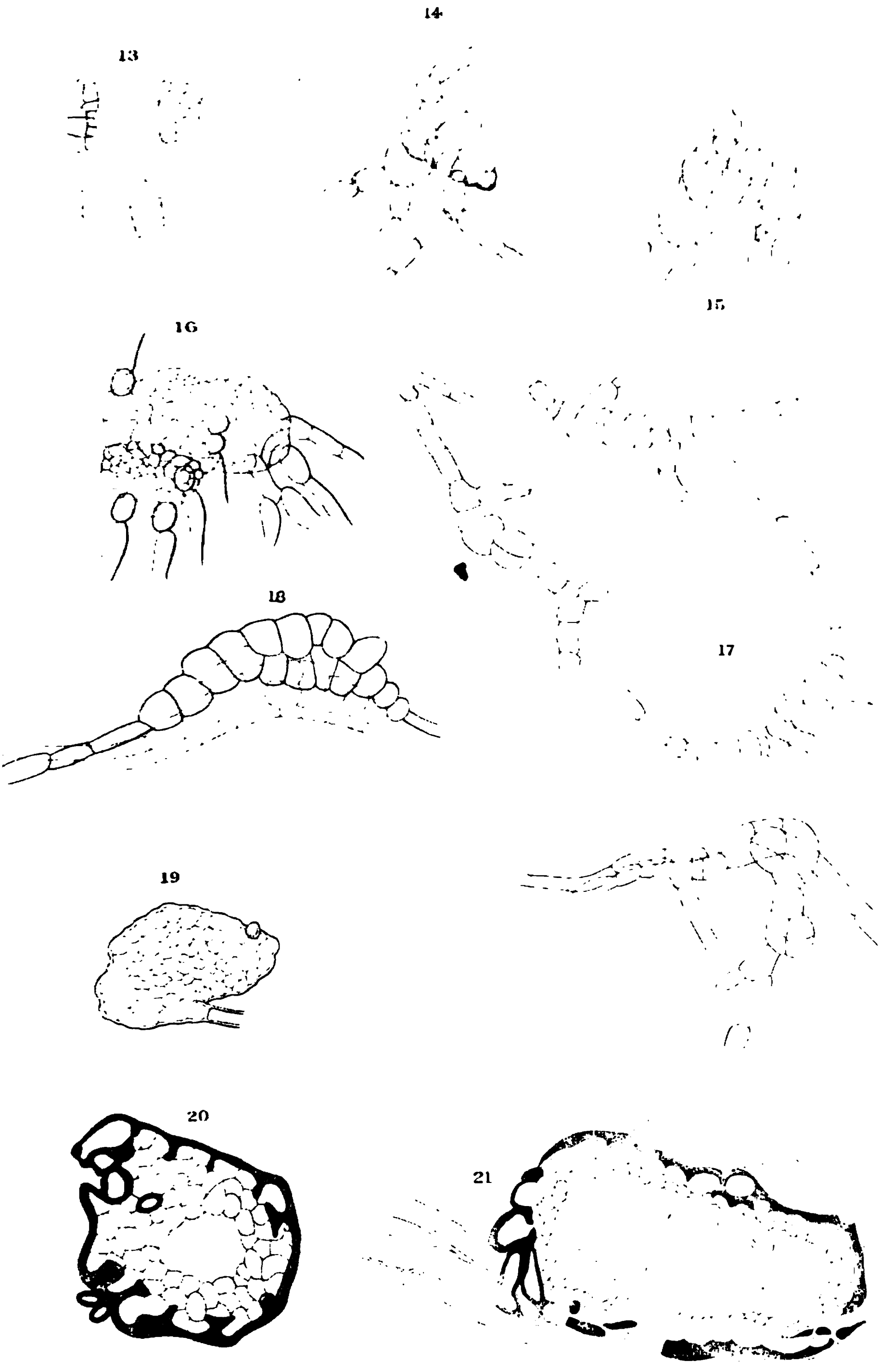
DESCRIPTION OF PLATES.

PLATE XIII (*after Von Tavel.*)

FIG. 13. ***Cucurbitaria platani***, Von Tav.; ascospores × 380.
14. Formation of sporopycnidium; the spore three days after sowing. × 380.
15. The same spore five hours later × 380.
16. The same spore twenty hours later × 380.
17. Beginnings of pycnidia × 600.
18. A later stage of the same × 600.
19. Section through a young pycnidium, the cavity not yet formed × 700.
20. Section through an older pycnidium × 700.
21. Section through a fully-formed pycnidium × 700.

PLATE XIV (*G. Massee, del.*)

FIG. 1. ***Tremella tremelloides***, (Berk.) Mass., portion of a plant, natural size.
1 *a*. Basidia and spores of same × 400.
2. ***Stella Americana***, Mass.; specimen natural size.
2 *a*. Vertical section of same, natural size; (*a*) outer wall of peridium; (*b*) inner layer.
2 *b*. Spores of same × 350.
2 *c*. Spore of same, showing epispore, as seen when × 1,200.
3. ***Trichosporium Curtisii***, Mass.; portion of a specimen natural size.
4. ***Trichosporium phyrrhosporium***, (Berk.) Mass.; (*a*) conidia; (*b*) a condiophore detached from its hypha, all × 350.
5. ***Trichosporium apiosporium***, (B. & Br.) Mass.; conidia × 350.
6. ***Badhamia nodulosa***, (Cke. & Balf.) Mass.; entire specimens × 40.
6 *a*. Portion of capillitium and spores of same × 350.
6 *b*. Spore of same × 1200.
7. ***Physarum scyphoides***, Cooke and Balf.; specimens × 40.
7 *a*. Portion of capillitium and spores of same × 350.
7 *b*. Spore of same × 1200.
8. ***Tilmadoche gyrocephala***, Rost.; specimen × 40.
8 *a*. Portion of capillitium and spores of same × 350.
8 *b*. Spore of same × 1200.



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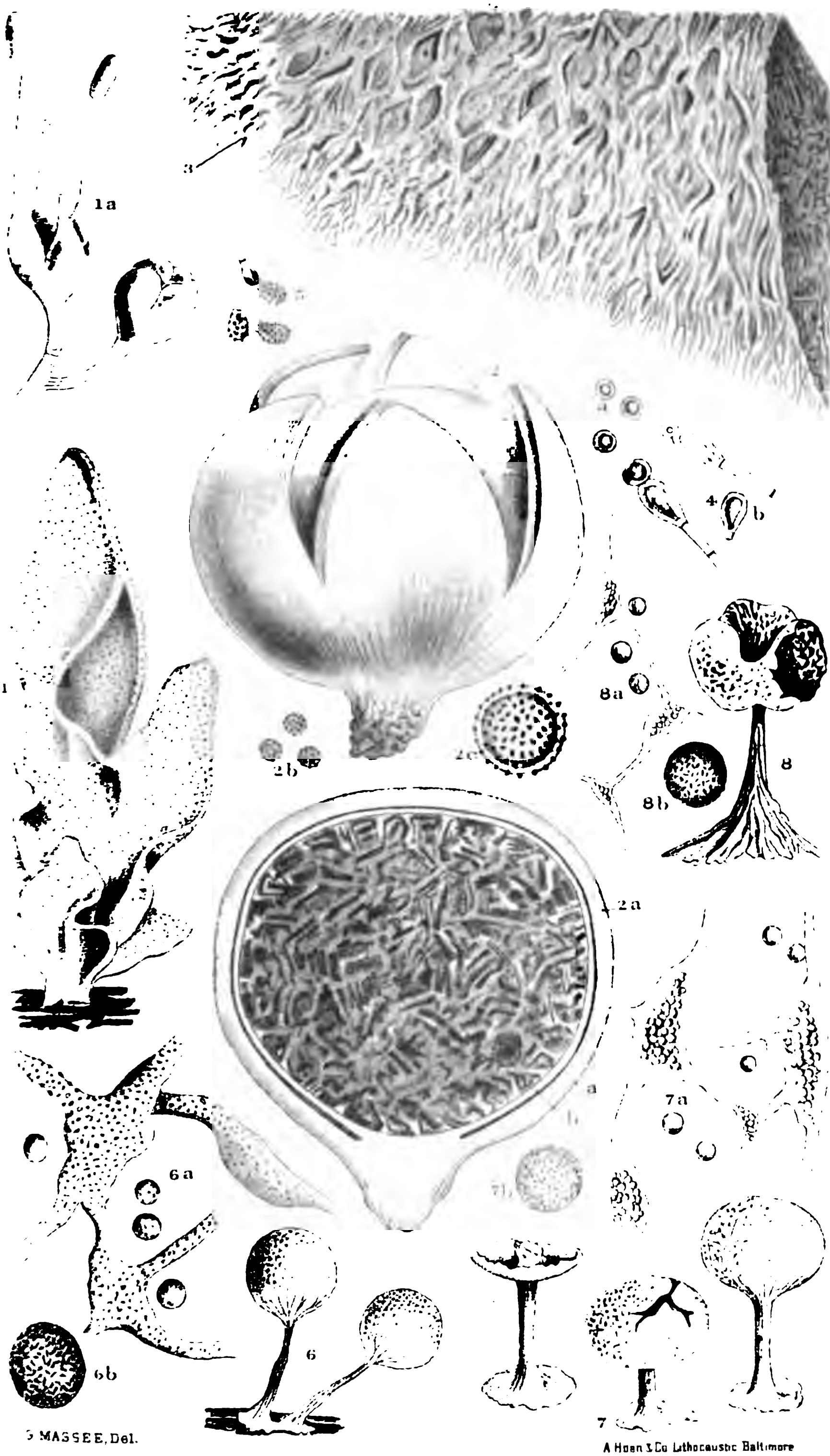
VON TAVEL ON DEVELOPMENT OF THE PYRENOMYCETES.



G. MASSEE, Del.

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[NOTE.—Fungi described in the text are in small capitals, synonyms in italics.]

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THE JOURNAL OF MYCOLOGY:

DEVOTED TO THE STUDY OF FUNGI, ESPECIALLY IN THEIR RELATION TO PLANT DISEASES.

BY

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THE CHIEF AND HIS ASSISTANTS.

CHIEF,
B. T. GALLOWAY.

ASSISTANTS,
EFFIE A. SOUTHWORTH. DAVID G. FAIRCHILD. ERWIN F. SMITH.

RECENT INVESTIGATIONS OF SMUT FUNGI AND SMUT DISEASES.

AN ADDRESS DELIVERED BEFORE THE SOCIETY OF AGRICULTURISTS OF BERLIN, FEBRUARY 17, 1888.

BY DR. OSKAR BREFELD,
Full Professor of Botany in Münster i. W.

[Translated from *Nachrichten aus dem Klub der Landwirthe zu Berlin*, Nos. 220–222, by Erwin F. Smith.]

GENTLEMEN: About four years ago, in January, 1884, I found opportunity in this place to report the new researches which I had completed upon the smut fungi, the *Ustilagineæ*. To this first communication I will to-day add a continuation explaining the results which I have obtained since my last address.

In nature the smut fungi live as parasites, in a multitude of forms. We find them universally distributed on the most dissimilar plants, but most frequently upon our cultivated plants and among these, especially, upon the different cereals. The usually striking and ruinous destructions which they produce in the host plants, and especially in the fruit-bearing portion, the spikes and panicles of grain, have been known and feared by farmers for a long time, under the name of smut diseases, or the phenomena of grain smut. The grain smuts belong without doubt to those plant diseases which operate most destructively, in that they destroy the chief aim of cultivation, the grain itself. For this reason first of all they have a very just claim to the most exact research for their recognition and prevention.

As a matter of fact, researches on the smut fungi and observations and experiments on the appearance and prevention of smut diseases have been made repeatedly for a long time and have often claimed

attention. Keeping step with further knowledge and experience in mycology they are always taken up afresh whenever any new suggestions or new views for further enlightenment open up, and whenever new methods of research show new points for attack.

In this way, then, my researches on the smut fungi and diseases, begun about eight years ago, were only the natural continuation of the labors of earlier authors; except that they were accompanied by other and fresh thoughts and supported by methodical expedients such as previously had not found employment, nor, indeed, could find it. They were begun after a long stand-still in observations on smut fungi and smut diseases, and when renewed experiments with the worn-out thoughts and methods would give no new and substantial results.

Till my experiments everybody proceeded upon the supposition that the fungi existing parasitically in nature found their natural conditions of existence only upon their hosts, and therefore that the different smut fungi could live and grow only upon the different but definite and restricted host plants, on which they were observed in the open air. Accordingly it was very evident that experiments and observations must be confined to the host plants; that in order to investigate the connection of fungus and disease, the fungous germs, found on the host plants, consequently the smut spores, must be sowed again upon the host plants and their development followed. The idea was so simple and natural that candid minds did not suspect the confusion of perception and judgment which this thought naturally carried with it.

Upon the host plants the smut spores find, first, only moisture for their development, consequently they must germinate on the surface of the plants just as they germinate in a small drop of water. Now, germination experiments with smut spores in water have shown most convincingly that the spores in many cases, *e. g.*, in corn smut, do not germinate; that in other cases they germinate only in small numbers and very imperfectly, *e. g.*, in oat smut and millet smut. From these negative or at least imperfect results of germination in water, which results were to be observed in just the same way upon the surface of the host plants, the universal distribution of the fungi in question and of the smut diseases in grain could be explained only very imperfectly or not at all. Nevertheless, these explanations gave satisfaction, the rudimentary consistency of facts was regarded as complete, and to no mycologist did it occur that any one would succeed in acquiring new information or in making a very important advance in the knowledge of smut diseases.

My culture methods for the investigation of fungi, were slowly and painfully established and brought to gradual completion during the long period of more than sixteen years, and meanwhile put to use, alike in the minute schizomycetes and the great mushrooms, in the simplest as well as the most highly developed fungous forms, with similar trenchant results for knowledge of the developmental history of fungi. These

led me, in their further perfection, gradually to results which made the difference between fungous forms that maintain themselves as parasites on living plants and animals, and such as live only as saprophytes on dead organic substances, appear less sharp than, according to the common state in nature, it was believed to be. I succeeded artificially, with my nutrient solutions, in growing fungous forms as luxuriant as were to be observed in nature on the host plants, and in some cases much more luxuriant, *e. g.*, *Peziza ciborioides* and *P. sclerotiorum*, which in nature are found living on clover and rape; also, *Sphacelia segetum*, the fungus of ergot, and many others. This itself led me to considerations on *the nature and reality of parasitism and on the way in which the various parasitic phenomena in nature might come about.* These observations always led only to the one reasonable conclusion, *that parasitism can be nothing else than a form of existence which has become more or less suited to the fungus according to the length of time, and differently and specifically adapted to it in each individual case, but which, for all that, has become by no means constant.* It was only the natural consequence of these trains of thought, based upon observations in nature, and upon the results obtained in my culture experiments, to draw this conclusion: *Even in the most distinctly marked cases of parasitism, in which the fungus is found only on given plants or even on particular portions of these, nothing else is before us except the furthest extended phenomena of the same adaptation, which by its more developed form produces the OUTWARD APPEARANCE, as though the natural conditions for the existence of these parasites were given exclusively in the living substratum, consequently in the particular host plants, or special portions of these, and as though every other way of life and growth were altogether excluded.*

And by this outward appearance all mycologists were obviously captivated, until my investigations. No botanist had thought of critically examining the essential nature of parasitism, of following out naturally the sole possible origin of parasitic phenomena, and of making it clear in what way the whole multitude of its variations is simply and naturally subordinate to one unifying thought, *a thought which included in itself not only the possibility but also the probability that fungi living parasitically—at least the greater part, if not all of them—can live outside of the host plant.*

When, almost ten years ago, I gave publicity to my views on parasitism along with my culture methods, and at the same time expressed strong confidence that unquestionably it must be possible artificially to cultivate most, if not all, parasitic fungi, my views remained not only generally unconsidered, but were in special cases, in the *Botanische Zeitung*, even scornfully criticised. This circumstance shows, as no other, the confused judgment of mycologists upon parasites and parasitism, and enables one to measure clearly the difference between the old sterile ideas and the new fruitful thoughts. Only this confusion of ideas, which must be plain upon considerate reflection, could have prevented

the earlier mycologists from at once *striking into the broader way for the investigation of parasites, the method of cultivation in artificial nutrient solutions instead of in mere water.*

As great as the fundamental difference in ways of thinking and methods which separates the earlier and the present investigations, so great is the difference in the results obtained, as I shall now show more explicitly in further experiments with the smut fungi.

Even in my first address on smut fungi and smut diseases, in 1884, I communicated important and unexpected results which I had then reached in cultivating different smut spores in artificial nutrient solutions.* While *in mere water* the smut spores either did not germinate, *e. g.*, the spores of corn smut, or germinated only scantily and concluded their development with the formation of a short germ tube (promycelium) and a few germ cells (conidia or sporidia); the same spores germinated *in nutrient solutions* without exception, the germ tubes produced conidia in inexhaustible abundance,† which only grew out into germ tubes when the nutrient solution was exhausted. The conidia were of definite shape and size, therefore specific for the individual forms of the smut fungi. In a number of forms they were produced *under liquid*, *e. g.*, in *Ustilago carbo*, *U. cruenta*, *U. maydis*, which are known as oat, millet, and corn smut; in other forms they were produced above the liquid *in the air*, *e. g.*, in the stone smut of wheat, *Tilletia caries*. In this fungus and the forms related to it there grew further in nutrient solutions, out of the conidia derived from spore germination, large, richly branched mycelia, which again produced the same conidia in unlimited abundance as short lateral shoots; *there arose, in fact, mold-like turfs*, which were again produced out of the new-formed and again new-sowed conidia, always in the same manner and abundance, so long as the culture was maintained in the nutrient solution. In oat, millet, and corn smut, and forms closely related to these, the further development of the conidia produced by spore germination under the nutrient solution continues not mold-like, but quite otherwise. *The conidia of definite size and shape produced on the short germ tubes of the smut spores multiplied in just this size and shape by direct sprouting at definite places, and that always at both ends, in a rapid manner, without limit.*

Furthermore, the sprout-colonies of conidia which were so produced,

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* Additional cultures with parasites selected at random resulted in showing that in almost all cases maintenance outside of the host plant is easy to accomplish; even the lichen forming *Ascomycetes*, which live on and with different algæ, representing the so-called lichens of nature, could be easily cultivated "without algæ" in my nutrient solutions with the help of my culture methods, as final valid proof that lichens are nothing but a number of *Ascomycetes* which live parasitically on different algæ. *Vide* Möller, *Kultur flechtenbildender Ascomyceten ohne Algen*. Arbeiten aus dem botanischen Institute in Münster i. W., 1887.

† For those who only read my address and have not seen the accompanying illustrations on the wall charts, I refer to the tables in my book *Brandpilze* I.

and which easily separated into their individual members, enabled us to recognize in the different forms of smut fungi, to which they belong as stages of the development, a different but always definite and typical appearance, depending on the form and size of their conidia. Thus, for example, the sprout conidia in oat smut (*Flugbrand*) were produced from the long egg-form conidia of this smut; the sprout colonies of the corn smut were made up of the longer somewhat spindle-form conidia, peculiar to this smut fungus; the sprout aggregations of the millet smut had the narrow spindle form of the conidia of this fungus. Even in the different species of the smut genus *Ustilago*, investigated four years ago, there were found "as characteristic stages of the development," just as many specific and different sprout forms as are found round to elongate conidia of the various sizes.

In their appearance and in their growth by sprouting these aggregations of conidia in the smut fungi are also similar to the large number of those long-known fungous forms which, from their characteristic growth and increase by so called sprouting, it has been thought necessary to consider as specific forms, and also to specially distinguish as SPROUTING FUNGI. They also show themselves fully consonant with the previously known sprout fungi in that, like them, they continued sprouting indefinitely, so long as they vegetated in congenial nutrient solutions; and in that they always remained in sprout form, consequently staid sprouting fungi, and passed over into no other form, only at most, not always, pushed out into germ tubes, when the nutrient solutions were exhausted. The sole difference, a negative one, however, between the newly discovered sprout forms of the various smut fungi and the fungus forms previously passing current as "sprout fungi" par excellence, which forms we encounter so very frequently in our nutrient solutions, and designate briefly as "mold (Kahm) fungi," or "yeast fungi," could be expressed only as follows: We now know the yeast or conidia-sprouts of the smut fungi not simply by their endlessly continued sprouting in nutrient solutions; we know further through the first beginnings of the culture, the sowed smut spores, that they represent nothing but special stages of development of the various smut fungi from which they were evolved; so far we do not know this of the other sprout fungi, because they have not yet been investigated from the right points of departure. From this it follows, further, that we do not judge correctly when we hold the so-called sprout fungi for independent fungi, as has been done hitherto, upon the fact alone of their endless sprouting in nutrient solutions. From the definite form of their individual members and the definite places of sprouting these must rather pass for nothing else than simple conidia sprouts of other fungi, consequently for stages in the development of higher fungous forms, which when sprouting in nutrient solutions behave like independent fungi, in just the same way as do the sprout-conidia of the smut fungi. *Artificial culture of the different smut fungi in nutrient solutions brought along then in its train as a side issue the obvious solu-*

tion of another still open question, the sprout-fungus or yeast question. It could only be considered as a simple matter of time when, through the spore culture of the remaining higher fungi, further and supplementary proof would be brought as to which forms among these fungi include in their course of development the still remaining sprout fungi which do not belong to the various smut fungi. The investigations in this direction have meanwhile, it may be mentioned in passing, already led to the most far-reaching results in the most diverse Ascomycetes and Basidiomycetes.

Aside now from the forms of smut fungi which, like *Tilletia*, produce large mycelia with conidia in nutrient solutions, and aside further from the forms which, like *Ustilago carbo*, *U. cruenta*, and *U. maydis*, produce conidia in endless sprouting in yeast form, there are still *other forms which produce conidia on the conidiophores of the germinating smut spores* (*the promycelia*), *which do not sprout directly, but always first grow out again into new promycelia until the conidia sprouting begins anew on these.* Here belong, for example, *Ustilago longissima* on *Poa aquatica*, and *U. grandis* on *Phragmites communis*, with many-celled promycelia, and *U. bromivora* on *Bromus secalinus*, with typical two-celled promycelia.

Finally, forms were also discovered, as for example *Ustilago Crameri* on *Setaria*, *U. hypodytes* on *Elymus arenarius*, etc., the *smut spores of which, germinating in nutrient solutions, produce no conidia, but only sterile germ tubes, that grow into richly-branched mycelia, which in turn also remain free from conidia.* Here afterward the single threads pushed far out, stolon-like, and abjointing, constituted, in place of the absent conidia, the richly increased mass of germs present in the nutrient solutions.

In short, these are the most essential results which the cultivation of the spores of the various smut fungi in artificial substrata, in nutrient solutions (therefore outside of the host plants, where they are found in nature) had given four years ago. The number of forms the cultivation of which was tried in nutrient solutions then amounted to more than twenty. As supplementary, I have extended the cultivation to an additional twenty forms, some of which brought to light similar peculiarities as in the first series, *e. g.*, in the genera *Schizonella* and *Tolyposporium*, which produce sprout-conidia; while others yielded new and supplementary facts, the special communication of which however, * as well

* Only incidentally I will state for example that the genus *Neovossia* and species of *Urocystis* behaved the same as *Tilletia*. Of the recently investigated forms of the old genus *Ustilago*, which in its present extent is wholly untenable, a number behaved the same as *Ustilago carbo*, and produced sprout-conidia of various shapes; others, *e. g.*, *U. caricis*, *U. subinclusa*, and *U. echinata*, germinated in a specific manner with the production of little conidiophores bearing air conidia similar to *Peronospora*. *Ustilago Vaillantii* agreed with the type of *U. longissima*; *U. hordei*, a recently distinguished form on *Hordeaceæ*, produced large, sterile, *e. g.*, conidia-free, mycelia, like *U. Crameri*, etc.

as the conclusion I have reached as to the morphological value of smut spores and as to the natural position of the smut fungi in the system of fungi, will be omitted here because they possess a strictly botanical scientific value, but do not directly contribute to the understanding of smut diseases, and their propagation, subjects now specially in question.

From the ease and luxuriance with which these cultivated parasites, vegetated and fructified in the nutrient solutions, with most abundant increase of their germ cells in just the same way as any other fungous forms occurring in nature as saprophytes, the conclusion followed almost of itself that smut fungi can also vegetate in nature on dead substrata like all other saprophytes, and that, although invisible to the naked eye, they here run through just the same forms as were found in the nutrient solutions and have just been described. This conclusion found still further support in the fact that I had used as nutrient solutions and nutrient substrata for the smut fungi the entire series of media, the composition and compounding of which I had given in detail in my *Culture Methods for the Investigation of Fungi* and had ascertained as suitable for the cultivation of saprophytic fungi, especially extracts from the fresh dung of our domestic animals, in which the development of the smut fungi took place with the same ease as all other saprophytes which were cultivated therein. The wide-spread occurrence of the most various yeast conidia in the dung of herbivorous animals, conidia which are in no way different from those of the investigated smut fungi, was in accord with this conclusion, and further experiments by sowing smut spores in fresh dung not too wet proved directly the increase of the germs in the fresh dung substances of the earth. Finally, the long known and uniform statements of husbandmen that their grain was especially subject to smut when they had impregnated the field with fresh dung found its equally simple and natural explanation in the now actually established increase of smut germs in the fresh dung.

Instead of smut spores almost incapable of germination in water, *e. g.*, corn smut; instead of only scattering and rudimentary spore germinations in mere water, *e. g.*, oat smut, from the activity of which, according to the knowledge of the time, the occurrence of smut and the spread of smut diseases could only be derived, there was now brought to light through the new discoveries and their consequences, an entirely new and rich vegetative condition of smut fungi. This made the question not one of exclusive parasites and their exclusive development on the host plants, but revealed, as it were, a most productive *center of infection, outside of the host plants*, for the propagation of smut diseases; a center of infection in which are operative not the few weak germs of water germination but an abundance of conidia capable of vigorous germination—conidia which can grow out easily into long germ-tubes and reach and attack the host plants.

However extremely probable or wholly self-evident it may now seem to have been from the beginning that germs of smut fungi, developed

in nutrient substrata of all sorts, might actually produce the smut diseases in the host plants; however convincing the experience of husbandmen on the relations of fresh dung to the appearance of smut diseases in grain,—the described results of artificial cultivation being also consonant—these alone do not amount to conclusive proof, but remain probabilities with which we can not be satisfied. *The new investigations of smut fungi, which began with the cultivation of the parasites outside of the host plants and which with the results here attained are half exhausted, will not be conclusive and exhaustive for the ætiology of smut diseases until the supplementary half is appended, until through various and rationally conducted infection experiments it is actually shown in what way and under what circumstances the richly multiplied germs living saprophytically outside of the host plants attack the latter and produce the smut diseases, how and in what places the germs penetrate into the host plants, and how within these, widely diverging from the transformations outside of the host plants, they are changed into smut spores.*

And now, for these infection experiments, the easy maintenance of smut fungi in any sort of nutrient solution and the subsequent endless increase of their germs, offered an inexhaustable source for the production, at will, of an infective material no less fresh and vigorous than capable of attack—a material, immediately and easily available in all possible variations, never before used, and admirably adapted for the artificial production of smut diseases in the host plants.

(*To be continued.*)

ON THE EFFECTS OF CERTAIN FUNGICIDES UPON THE VITALITY OF SEEDS.

A. A. CROZIER.

The influence of various chemicals upon the germination of seeds is but little understood. Many which have a fertilizing effect when applied in small amounts to the growing plant are injurious when a strong solution is applied to the seed. There is evidence, on the other hand, that many substances when applied to the seed will hasten germination and increase the vigor of the young plants. An account of some of these is given by Prof. L. H. Bailey, in Bulletin 31 of the Michigan Agricultural College.

The following experiments were made with blue vitriol and copperas at the Iowa Experiment Station in 1889:

First, a rough test was made with a strong solution of blue vitriol, a teaspoonful in half a saucer of water. Corn was soaked in this twenty-four hours, and another lot soaked in pure water the same length of time, and both lots planted in soil in the greenhouse May 11. Examination was made daily with the following results, the figures showing

the number of plants which had appeared above the soil on the given dates, 100 seeds of each having been planted:

I.—*Blue vitriol upon corn.*

Date.	Twenty-four hours.		Date.	Twenty-four hours.	
	Water.	Blue vitriol.		Water.	Blue vitriol.
May 16	57	5	May 24	98	85
17	96	45	25	98	86
18	97	52	26	98	86
19	97	56	27	96	86
20	98	71	28	98	87
21	98	77	29	98	87
22	98	79	30	90	87
23	98	80	31	99	89

The above table shows that the treatment with blue vitriol prevented the germination of some of the seeds and greatly retarded the germination of most of the others. Many of the plants from the seeds treated with the blue vitriol came up feeble, with leaves which appeared as though scorched. On June 7, a part of these plants had become healthy, but they were as a whole much smaller than those from the seed soaked in water only. The set treated with vitriol contained twenty-eight plants, which were notably weak, and the other set but three weak plants.

The next trial was with a solution of 10 gallons of water containing 5 pounds of blue vitriol (see Circular 5, of Sect. Veg. Path. U. S. Dept. Ag., p. 5). The seeds were placed in the solutions on May 28, and allowed to remain for three different periods before planting. Examinations were made at the dates indicated, the figures showing the number of plants which had appeared above the soil from time to time. One hundred seeds were planted in each case as before.

II.—*Blue vitriol upon corn.*

Date.	Ten minutes.		Five hours.		Twenty-four hours.	
	Water.	Blue vitriol.	Water.	Blue vitriol.	Water.	Blue vitriol.
June 5	10	5	0	0	2	0
6	57	41	20	7	40	20
7	81	63	75	41	77	60
8	91	85	91	72	87	75
9	95	87	93	85	89	79
10	95	89	93	87	91	88
11	95	92	93	91	93	93

Here a general retarding effect of the blue vitriol is visible, even when the application was made for the shortest time. The exceptions which appear are not sufficient to disturb the general result. There was also an enfeebling effect upon the young plants. On June 8 there were in the lot from seed which were soaked in water for ten minutes 6 feeble plants, and in that treated with vitriol for the same time, 23; in the lot treated with water five hours, 12; in that with vitriol, 19; in the lot treated with water twenty-four hours, 4; in that with vitriol, 22; making a total from 300 seeds soaked in water of 22 feeble plants, and from the same number soaked in blue vitriol, of 64.

The next table shows the results of the same solution upon wheat, the dates and conditions being the same as above.

III.—*Blue vitriol upon wheat.*

Date.	Ten minutes.		Five hours.		Twenty-four hours.	
	Water.	Blue vitriol.	Water.	Blue vitriol.	Water.	Blue vitriol.
June 5	77	46	60	23	45	2
6	81	55	77	40	82	10
7	81	58	78	42	86	16
8	82	62	82	43	91	23
9	83	74	85	45	92	29
10	83	79	85	45	92	34
11	85	80	85	48	93	37

It will be noticed from the above table that the wheat germinated much more quickly than the corn, and that the injurious effect of the blue vitriol was somewhat greater.

A more severe test was made with the same solution of blue vitriol (5 pounds to 10 gallons) upon the same sample of wheat by allowing about a pint of the seed to remain in the solution for thirty-nine hours, and the same amount in water for an equal length of time. At the end of that time the water was turned off, a part of the seeds of each lot kept damp by blotting paper, and the remainder planted. Nearly all the seeds which had been in water grew well, but none of those which had been in the solution of blue vitriol.

The next trial was of a solution of copperas or green vitriol upon corn. Copperas is used as a fertilizer, as a fungicide, and as an insecticide. Griffeth in his treatise on manures (London, 1889) after treating extensively of its use as a fertilizer, mentions its value as a fungicide, and states (page 302) that all fungous diseases of wheat may be destroyed by a top dressing of 50 pounds of copperas per acre, or by soaking the seed in a 1 per cent. solution.

In Bulletin 5 of the Iowa experiment station, on page 164, reference is made to the use of copperas as a remedy for cut-worms, the amount recommended being a little over 1 pound for a bushel of seed, with water sufficient to cover the grain.

This strength was taken for the trial, comparison being made with a much stronger solution, and also with pure water. The trial was made in duplicate, one set in the green-house, the other in the open ground, the other conditions being the same. The seed was soaked in each case twenty-four hours, and planted May 17, 100 kernels in a place as in the other tests. The examination was made daily, and, as in the other cases, as nearly as practicable at the same hour, usually at 6 a. m. The record begins on the day upon which the first plants appeared above ground.

IV.—*Copperas upon corn.*

Date.	(a) In the green-house.			(b) In the open ground.		
	Water.	Copperas, 1 pound per bushel.	Copperas very strong.	Water.	Copperas, 1 pound per bushel.	Copperas very strong.
May 24	51	35	16	12	1	1
May 25	84	70	45	45	32	20
May 26	91	79	68	68	65	59
May 27	94	86	72	80	76	73
May 28	94	87	80	82	80	74
May 29	94	88	85	83	81	79
May 30	94	93	86	84	86	79

A comparison of Tables IV with Tables I and II is sufficient to show that green vitriol (copperas) has nearly as injurious an effect upon the seed as blue vitriol. There was no scorching of the leaves noticeable, however, resulting from treatment with copperas, even with the strongest solution.

TREATMENT OF BLACK-ROT, BROWN-ROT, DOWNY MILDEW, POWDERY MILDEW, AND ANTHRACNOSE OF THE GRAPE; PEAR SCAB AND LEAF-BLIGHT, AND APPLE POWDERY MILDEW.

By B. T. Galloway.

BLACK-ROT.*

The experiments of the past two years have demonstrated beyond question the possibility of cheaply and effectively preventing this disease. Many things, however, in connection with its treatment remain to be discovered, so that rules now laid down will probably have to be modified, as future work gives us a better insight into the nature of the disease and the effects of different fungicides upon it. In the light of our present knowledge we would suggest the following lines of treatment, from which we will leave our readers to make their own selec-

***Læstadia Bidwellii*, (Sacc.) V. R.

tions, since there is little choice, so far as the actual value of the remedies are concerned.

I. After pruning, collect and burn all the trimmings, also as many of the old berries and leaves as possible; the object of this is to destroy the fungous spores which are known to pass the winter in these parts. This accomplished, watch the vines carefully, and as the leaves begin to unfold apply the Bordeaux mixture, formula *b*, taking care to have it reach all parts of the vine above ground. About the time the flowers are opening make a second application of the same formula, this time giving particular attention to the green parts. A third spraying should be made twelve or fifteen days later, a fourth after the lapse of a similar period, and so on until the berries begin to color. A line of treatment, such as the foregoing, will necessitate six or seven sprayings, and the total cost of the same will probably range from $5.50 to $7 per acre, or practically 1 cent per vine.

II. Treat the vines exactly as in I, excepting the first application; which may be omitted entirely, the first spraying being the one made when the flowers are opening. It is not out of place to say here that in no case should the first spraying be postponed later than the last-mentioned period. This treatment will, of course, cost less than I, but whether it will pay to omit the first spraying is one of the questions not yet determined.

III. Treat the same as I, but after the third application abandon the Bordeaux mixture and substitute the ammoniacal solution of copper carbonate. It is very likely that this treatment will prove as effectual as I; at the same time the cost will be less, and the troublesome spotting of the fruit, which always results from the use of the Bordeaux mixture, will be avoided.

IV. Substitute the ammoniacal copper carbonate for the Bordeaux mixture, making the first spraying when the flowers are opening and the others the same as in I. Former experiments have led us to believe that in ordinary seasons this solution will prove as effective as the Bordeaux mixture, and its advantages over the latter are (*a*) ease of preparation and application, (*b*) cheapness, and (*c*) its property of not spotting the fruit.

Those desiring to make further trials should test the effect of spraying the vines in spring, before vegetation starts, with the simple solution of copper sulphate or Bordeaux mixture, formula *a*. It is claimed by some that this early treatment has resulted in much good, but on the other hand there are those who have derived no benefit whatever from it. The question is one to be settled by careful experiments. For further remarks on this subject, see Notes on Fungicides.

BROWN-ROT AND DOWNY MILDEW.*

These diseases, which are caused by the same fungus, occur in nearly all sections where black-rot prevails, and experience has shown that one treatment will answer for all. In the great grape-growing regions

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* *Peronospora viticola*, DBy.

of northern Ohio and central and eastern New York, where the downy mildew is the principal enemy, the ammoniacal copper carbonate solution will prove an effectual preventive. It should be applied thoroughly to all the green parts of the vine, taking care to make the first application *before any signs of mildew have appeared*—say, soon after the berries are well set. The importance of early treatment can not be too strongly urged. In all cases it must be remembered that these treatments are *preventive*, and being such, it is sheer folly to wait until the enemy appears before beginning the fight.

POWDERY MILDEW.*

It is only in certain parts of the South and along the Pacific coast that this fungus causes any serious damage. In California it has long been the bane of the grape-grower, and this is strange, considering the fact that it is one of the easiest diseases to combat. It succumbs readily to sulphur either in the form of the flowers of sulphur or solutions of the sulphide.

In applying the sulphur, bellows should be used, and the first applications should be made ten or twelve days before the flowers open, the second when in full bloom, and a third three weeks or a month later if the disease seems to be on the increase. The best results are obtained when the applications are made with the thermometer ranging from 80 to 100° F. In this temperature fumes are given off, which quickly destroy the fungus.

We have obtained excellent results in treating this disease with a solution made by dissolving half an ounce of potassium sulphide to the gallon of water. This preparation is cheap and can be quickly and effectually applied with any of the well known spraying pumps. The greatest care should be exercised in making the second spraying, which, by the way, should be at the same time as that mentioned for the flowers of sulphur, in order to protect the blossoms from the fungus.

ANTHRACNOSE.†

This is one of the most difficult of all the grape diseases to combat; in fact we must admit that so far no reliable means of preventing it are known. We can only suggest, therefore, such lines of treatment as have given the best results, hoping that future investigations may throw more light on the subject.

In early spring, before the buds swell, remove, so far as possible, the wood showing the scars made by the fungus, and then treat the vines with a saturated solution (20 per cent. at 20° C.) of iron sulphate. The French apply this by means of mops made of rags, attached to short handles. This is rather slow and awkward work, and we prefer to do it with a spraying machine. As soon as vegetation starts watch the vines carefully, and at the first appearance of the disease apply

* *Uncinula ampelopsidis*, Pk. † *Sphaceloma ampelinum*, DBy.

with a sulphuring bellows a powder made of equal parts of flowers of sulphur and slaked lime. If this does not check the malady, try the sulphur alone.

PEAR SCAB* AND LEAF-BLIGHT.†

Excepting the well known fire blight these diseases are the worst enemies of the pear. They are especially prevalent in New Jersey, Delaware, and adjoining States, frequently causing the loss of entire crops of fruit and thousands of seedlings. The seedlings are especially subject to leaf-blight, but are hardly ever, so far as we know, seriously injured by scab. As the two diseases, however, are usually associated on large trees, and as we have used the Bordeaux mixture successfully on the seedlings, we would suggest that it be adopted for all and applied as follows:

Seedlings.—Make five applications, the first when the leaves are one-quarter grown, others at intervals of ten days until the trees are budded.

Large trees.—Spray five times; first when the fruit is the size of peas, and thereafter at intervals of twelve or fifteen days.

For applying the mixture to trees less than 12 feet high, and especially to seedlings in the nursery, the knapsack pumps provided with the improved Vermorel lance and nozzle will answer.

Where the trees are large and in considerable numbers it will pay to get a strong force-pump, mount it on a barrel, and place the whole in a wagon or cart to be moved about at pleasure. In all cases, however, it will be necessary to use the Vermorel nozzle, as it is the only nozzle of value that will not clog; it can readily be attached to almost any force-pump, and will be found to be a very effective piece of machinery.

The total cost of a course of treatment such as is outlined above, including labor in preparing and applying the remedies, will be for nursery stock about $3 per 1,000 trees. For large bearing trees the cost will run from 6 to 12 cents per tree. In case the Bordeaux mixture shows on the fruit at the time of harvesting it can easily be removed by washing in water.

In addition to the foregoing it would be well to rake the old leaves and fruit together in the fall and burn them, as in this way thousands of the reproductive bodies will be destroyed.

In regions where the scab alone prevails the treatment recommended for apple scab might be tested.

POWDERY MILDEW OF THE APPLE.‡

Powdery mildew is especially destructive to seedlings in the nursery, attacking them soon after the leaves unfold and continuing throughout the growing season, making it impossible to bud them with any degree of success.

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* *Fusicladium dendriticum*, Fckl.

† *Entomosporium maculatum*, Lév.

‡ *Podosphæra oxyacanthæ* (DC.), DBy.

When the leaves are about one-third grown begin the treatment by spraying with the ammoniacal solution. In twelve days make a second application of this solution and continue at similar intervals until six or seven sprayings have been made. The applications are best made with the knapsack form of sprayer provided with the Eddy chamber nozzle. The spray of the Vermorel nozzle is too large for this work, but the Eddy chamber can be easily attached to the lance of the former at a cost of 75 cents.

The total cost of such a treatment as outlined above need not exceed 10 cents per 1,000 trees.

WHAT TO DO FOR PEACH YELLOWS.

By Erwin F. Smith.

A series of experiments with fertilizers was begun in 1889, and will be continued until complete and definite results are reached. These experiments are in twelve orchards in different localities and on a variety of soils, embracing a total of about 40 acres, with as many more for comparison. The results last year were not of such a nature as to warrant any affirmative conclusion or any general recommendation.

For the present, at least, I can only indorse the Michigan practice, which is to dig out and destroy every affected tree as soon as it is discovered.

In localities where this method has been practiced with some uniformity they still grow peaches successfully.

In the vicinity of Benton Harbor, Mich., where all the orchards were ruined between the years 1870 and 1880, there are now many fine young orchards, and the yellows has almost disappeared. In the summer of 1889, in company with Mr. Rufus H. Brunson, a former yellows commissioner, I visited many small orchards in different parts of the townships of Benton and St. Joseph, the former chief seat of the disease, and examined nearly 30,000 trees, finding only about fifty cases, nearly one-half of which were in one orchard. More than four-fifths of these trees were less than six years old. Many of the older ones, and most of those which I examined, were in fruit, and the earliest varieties were just coming into market, July 24. With a few exceptions, the only *extensive* orchards were young trees not yet in bearing, the earlier plantings having been numerous, but in a small and tentative way, no single individual caring to risk many thousand trees. Now, however, large orchards are being set. Whether the present immunity will continue is a matter of great interest. If there is any real basis for the belief that the disease may be imported, it certainly will not, for many of the younger trees were procured from infected districts in the East. All fear of the disease seems to have died out, and with it most of the former vigilance,

At South Haven, Mich., where the "rooting out" process was first practiced extensively, and where it is yet in full vigor, they have grown peaches continuously from the start (1852), and there are many old orchards, some of which have stood for twenty-five years. In that locality I examined many representative orchards, and found only a very few cases of yellows. Sometimes, as at St. Joseph, it was a day's work to find a single case. Most orchards of any size do, however, lose some trees each year, their places being filled by trees from the nursery. The South Haven growers, many of whom I have met, no longer fear the disease. They are unanimous in the opinion that the only proper thing is to dig out and burn. This plan they have followed very generally for the past ten years, during which time the disease has not prevailed seriously. Previous to that date many orchards were ruined, the disease having appeared first in 1869.

Until we have a full knowledge of the ætiology of this disease, no better plan can be suggested. Affected trees are always worthless, and the sooner they are converted into stove-wood the sooner new, healthy trees can be grown in their places. *Dig out, then, and burn, and do it promptly.*

TREATMENT OF MILDEWS UPON PLANTS UNDER GLASS.

By S. T. Maynard.

In Bulletin No. 4, Massachusetts Experiment Station, April, 1889, experiments were reported upon the causes and remedies for mildews upon plants under glass. Below we give a brief summary of the results.

ROSE MILDEW.*

Long experience in growing the rose has led many to believe that the rose mildew is brought on by various conditions that weaken the vigor of the leaf, such as want of an abundance of plant food in a proper condition, unhealthy condition of the soil, often resulting from improper drainage, irregular or overwatering, or too sudden changes of temperature, especially after the plants have been forced at a high temperature. The successful rose grower therefore, is one who, by constant care and good judgment, always provides against any or all of the above causes.

REMEDY.

A sure and safe remedy, *with proper precautions*, was found in *evaporated sulphur*. In the use of this remedy a small kerosene stove with a thin iron kettle was used, and the sulphur kept boiling two or three hours thrice each week when the house was closed.

**Sphærotheca pannosa*, (Wallr.) Lév.

Precaution.—The only precaution needed is that the apparatus be placed so that there shall be no danger of its getting upset, and that only heat enough be applied to *boil* the sulphur, for, if by any accident the sulphur should catch on fire, it would destroy all the plants in the house very quickly.

Suggestion.—It has been suggested that if the pipes are painted with linseed-oil and sulphur two or three times each year, similar good results would follow. It has long been the practice to paint greenhouse pipes with a mixture of lime and sulphur, but the results have not always been satisfactory, and the above suggestion may be open to the same objection, although we know of no carefully recorded experiments in the use of linseed-oil and sulphur paint.

LETTUCE MILDEW.*

When grown at a temperature above 40° F. at night, 55° F. in cloudy, and 70° F. in sunny days, lettuce under glass is often rendered unprofitable by the attack of this disease which causes the lower leaves to decay, and often the whole plant to die quickly. Other conditions may in a measure aid in bringing on the disease; for instance, anything that may cause a weak leaf-action of the plant, too much water in the soil, and too much moisture in the house, especially during the night.

REMEDY.

Evaporated sulphur proved beneficial, but not wholly preventive, in fact, only preventive conditions were found satisfactory. These conditions are:

1. A lower temperature at night than during the day, *i. e.*, ranging from 35° F. to 45° F. at night to 50° F. to 70° F. during the day. In sunny weather the temperature may run 10° to 15° higher than on cloudy days.
2. Perfect drainage of the soil.
3. A house naturally dry, light, and airy.
4. An abundance of plant-food in a light porous soil.

Should the plants not start into a vigorous growth soon after transplanting, the application of fine ground bone, one-half pound to a square yard, and 2 ounces of nitrate of soda to the same space, will give remarkable results.

Suggestion.—While it is possible by close and constant attention to provide conditions for the successful growth of both the rose and lettuce under glass, such care and attention adds very materially to the cost of the products, and some means should be devised to destroy the germs

* *Peronospora gangliformis*, Berk.

of these diseases. This may possibly be found in fungicides used in the houses, before the plants are started or by their application to the soil and growing crops while in a young state.

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TREATMENT OF CRANBERRY SCALD AND CRANBERRY GALL-FUNGUS.

By Byron D. Halsted.

It has been determined by a thorough canvass that a large fraction of the cranberry crop is destroyed by the scald, sometimes called "rot." The loss sometimes reaches as high as 65 per cent., and in many places it has rendered the growing of cranberries a profitless industry.

A fungus is closely associated with this scald, and in no case has a soft berry been examined microscopically without the same fungus being present. The leaves, vines, and roots also of the plants bearing scalded berries, abound in the same fungus. In general structure, habits, and behavior, the fungus of the cranberry scald is closely related to the one causing the black-rot of the grape. As yet no fungicides have been tested upon the scald, but from its relationship to the black-rot of the grape it is only reasonable to infer that the same treatment might be efficacious. In view of the fact that the cranberry has small smooth thick leaves it is possible that the mixtures employed for the grape could be used with greater strength upon the former. However, a beginning can be made with the ammoniacal copper carbonate solution, directions for the preparation of which will be found elsewhere in this Journal. The amount of this solution to be applied per acre can not be stated because it will vary with the rankness of the vines. Apply for the first time as soon as the spring flooding is past, and again just before the blossoms unfold. The third application should be in midsummer, followed by two others at intervals of two weeks. This makes five sprayings in all. The instruments to be used will depend much upon circumstances. If the owner applies Paris green or London purple for the insect enemies of the cranberry, namely, the tip worm, vine worm, etc., then the remedy for the scald can be applied with the same pump.

There is much to be done in improving the *sanitary* conditions, if that term may be used, of the bogs. It is important to have perfect control of the water supply, and during the growing season, while keeping the bog moist enough for the plants, have the ditches deep and free-flowing that stagnant water can be kept from the roots of the plants. Doubtless much depends upon having the soil of the bog in the best condition for the healthy growth of the plants. Where the peat is sour and soaked with standing water the best conditions obtain for the scald. It may be that proper drainage, water control, and

sanding will bring the necessary conditions for healthy plants, and the old plants may outgrow the trouble with the aid, in the meantime, of the remedy proposed. The best thing to do will be to try and see, upon a small area, provided the practical pecuniary test of possible profit prompts the owner. Some bogs are so poorly adapted for this peculiar industry that it will not pay to spend money upon them, others, nevertheless, merit much more attention than they receive.

THE GALL-FUNGUS.

This appears to be confined to a single bog in New Jersey, but in that one it is disastrous. Several closely related shore plants as azalea, sheep laurel, lambkill, white alder, leather leaf, huckleberry, and tea berry or winter green, are attacked by the same fungus (*Synchytrium Vaccinii*, Thomas). The disease is spread by the water in the spring floods and does not pass readily through the air. There is some danger, however, of the pest spreading to other bogs and therefore if this bog was destroyed by fire, together with the infested shore plants there might be hope for a speedy end to the trouble. The matter is so local that it does not merit further treatment here.

The two diseases of the cranberry herein briefly treated are considered at length, with several engravings, in Bulletin 64 of the New Jersey Experiment Station.

Rutgers College, New Brunswick, N. J.

TREATMENT OF APPLE SCAB.

By E. S. Goff.

Recent experiments indicate that apple scab (*Fusicladium dendriticum*, Fckl.) may be almost entirely prevented by the application of certain liquid preparations, in the form of a spray, that, while harmless to the foliage and fruit of the tree, are destructive to the fungus which causes the disease. Various substances have been found to be more or less beneficial, but at the present state of our knowledge, a solution of copper carbonate in ammonia largely diluted with water is to be most strongly recommended. Experiments conducted, the past season, in the orchard of Mr. A. L. Hatch, of Ithaca, Wis., with this preparation proved so far satisfactory that Mr. Hatch has decided to apply the treatment to his entire orchard of about 25 acres the coming season, as a means of increasing the income from his apple trees.

DIRECTIONS FOR PREPARING AND APPLYING THIS FUNGICIDE.

The copper carbonate and the ammonia may be procured through almost any retail druggist. As the former is not always kept in stock it would be well to order it some days before it is desired for use. The

copper carbonate should be of the "precipitated" form, and is worth at retail about 65 cents per pound. The ammonia should be of a strength of 22° Baumé, and should be procured in a glass or earthen vessel and kept tightly corked, preferably with a rubber cork.

Four ounces of the copper carbonate and 1 gallon of ammonia will be sufficient to give about fifty large or seventy-five medium-sized trees one thorough spraying. As four or five treatments will be needed for a thorough application of the remedy the amount of the materials required for any given orchard may be readily computed.

The best formula that can be given in the present state of our knowledge is to dissolve one ounce of the copper carbonate in one quart of ammonia, and dilute this, when ready to commence the application, with 25 gallons of water.

WHEN TO MAKE THE APPLICATIONS.

In the experiments made the past season in Mr. Hatch's orchard the first application was made after the petals of the flowers had fallen, and when the young apples were slightly larger than peas. But it is the opinion of Mr. Hatch and myself that one spraying before the flowers had opened would have proved beneficial. I would recommend, therefore, one treatment just before the flowers open, a second after the petals have entirely fallen, and others at intervals of two or three weeks until midsummer, or after, if the latter part of summer should be wet.

APPARATUS FOR SPRAYING.

For applying the liquid to the trees, a force-pump, to which is attached a few feet of hose, fitted at the end with a spraying nozzle, will be needed. Excellent pumps are now made by the larger manufacturers expressly for spraying purposes, fitted with all necessary attachments, and costing $10 and upwards. Smaller pumps, which would answer fairly well for a few trees, may be had at from $2 to $10 each.

The same pump which is used for treating the trees for the apple scab may of course be used for applying poisons for the codling moth and other insects. Unfortunately it will not be prudent to add the copper carbonate solution to the same water that is used in applying Paris green or London purple, as the ammonia renders the arsenic more or less soluble and thus the latter would be liable to injure the foliage. But if applied a few hours in advance of the water containing the arsenites, no harm can result from this source.

SUGGESTIONS FOR FURTHER EXPERIMENTS.

The time at which the applications should commence, the number that should be made, and the amount of copper carbonate to be used to accomplish the greatest benefit at the least cost, remain to be settled by experiment.

The most practical remedy for the apple scab must be one that may be applied in the same water with Paris green or London purple without thereby endangering the foliage. It is the opinion of our station chemist, Dr. Babcock, that not only the ammoniacal copper carbonate, but the sodium hyposulphite and the sulphides of lime and potash, all tend to render the arsenic of Paris green and London purple soluble, and hence can not be wisely used in connection with these poisons. The copper carbonate, however, which in the ammoniacal solution is the beneficial agent in preventing the apple scab, does not have this effect when used without the ammonia. The question therefore arises, is the ammonia solvent necessary?

I have recently made some tests with a sample of commercial precipitated copper carbonate, and find that its state of division is such that it remains suspended in water rather better than Paris green, and so may be applied by any apparatus that successfully distributes the latter. It apparently adheres to the foliage nearly or quite as well, when applied in simple suspension, as in the diluted ammoniacal solution.

I recommend, therefore, that those who spray their apple trees for the prevention of injury from the codling moth, make the experiment in a portion of the orchard of adding the precipitated copper carbonate to the water, at the rate of an ounce to twenty-five gallons. No harm to the foliage can result from this measure, while we have every reason to expect that much benefit will accrue in the prevention of the apple scab.

UNIVERSITY OF WISCONSIN, MADISON, WIS.

THE COPPER SALTS AS FUNGICIDES.

BY F. D. CHESTER.

In order to make an intelligent comparison between the several well known fungicides containing copper, it is important to understand what salts of copper occur in each and in what relative proportions. This in turn involves some inquiry into the chemical reactions which take place in their preparation and during their stay upon the vine.

For much valuable assistance in the preparation of these notes I am indebted to Prof. C. L. Penny, the Chemist of this Station.

THE BORDEAUX MIXTURE.

Formula.—Copper sulphate, 6 pounds; lime, 6 pounds; water, 22 gallons. In the addition of milk of lime to a solution of copper sulphate, the lime in solution precipitates the copper as cupric hydroxide, forming at the same time a slightly soluuble sulphate of lime. These two salts, together with an excess of lime, remain in suspension in the Bordeaux mixture.

The reaction is simple:

$$CuSO_4, 5H_2O + CaO,H_2O = Cu\ (OH)_2 + CaSO_4 + 5H_2O.$$

From this formula a simple calculation shows that to precipitate the 6 pounds of copper sulphate, there would be required 1.34 pounds of lime (CaO), which would in turn produce 2.34 pounds of cupric hydroxide.

The weight of lime to be used should be considerably increased above this amount, owing to its impure character as ordinarily purchased, but it is likely that 3 or 4 pounds of commercial lime will suffice to satisfy this reaction.

The 22 gallons of water is capable of dissolving approximately .235 pounds of lime, an amount sufficient to precipitate practically 1 pound of the copper sulphate. But since this quantity of lime is immediately thrown down as a nearly insoluble sulphate, the water is free to dissolve another portion of lime, which in turn precipitates another portion of the copper, until all of the copper is thrown down. It is found that this complete precipitation of the copper takes place quickly, or by the time the matter in suspension has fully settled, leaving a clear supernatant liquid, which does not react for copper; hence a long standing of the Bordeaux mixture before use is hardly necessary.

In drying upon the plant the cupric hydroxide in the Bordeaux mixture undergoes no change, hence it is probably this salt of copper which is the active principle.

EAU CELESTE.

Formula.—Copper sulphate, 1 pound; strong ammonia, 1½ pints; water, 22 gallons.

In the addition of ammonia water to a solution of normal copper sulphate, the copper is precipitated as a basic sulphate, forming at the same time ammonic sulphate, which remains in solution. With an excess of ammonia, the basic copper sulphate dissolves to a blue fluid forming the ammonio-copper sulphate ($CuSO_4$, $4NH_3$, H_2O).

In drying upon the plant the ammonio-copper sulphate gradually loses its ammonia and is reconverted into the basic copper sulphate. The following are the probable reactions:

(1) $$\underbrace{3CuSO_4, 5H_2O}_{\text{Normal copper sulphate}} + 4NH_4HO = \underbrace{CuSO_4\ 2Cu(OH)_2}_{\text{Basic copper sulphate.}} + 2(NH_4)_2\ SO_4 + 15H_2O$$

(2) $$CuSO_4, 2Cu(OH)_2 + 2(NH_4)_2SO_4 + \underbrace{8NH_4HO}_{\text{In excess.}} = \underbrace{3(CuSO_4, 4NH_3, H_2O)}_{\text{Ammonium copper sulphate.}} + 9H_2O$$

(3) In drying upon the vine.
$$3(CuSO_4, 4NH_3, H_2O) + H_2O = CuSO_4, 2Cu(OH)_2 + 2(NH_4)_2SO_4 + 8NH_3$$

To satisfy the reactions (1) and (2), the one pound of copper sulphate would require .439 pounds of ammonia gas (NH_3); or 1.66 pints of the

stronger water of ammonia of the U. S. Pharmacopœia (sp. gr. 0.900 at 15° C.), producing in turn .47 pounds of the basic copper sulphate.

MODIFIED EAU CELESTE.

Formula.—Sulphate of copper, 2 pounds; carbonate of soda, 2½ pounds; strong ammonia, 1½ pints; water, 22 gallons. In the addition of a solution of sodic carbonate to a solution of copper carbonate the copper is precipitated as a basic carbonate, forming at the same time a soluble sulphate of soda.

Upon the addition of ammonia the basic carbonate dissolves to a blue fluid forming the ammonio-copper carbonate ($CuCO_3$, $2NH_3$), and the ammonio-cupric hydroxide. ($3Cu(OH)_2$, $4NH_3$, $3H_2O$.)

In drying upon the plant both of these salts gradually lose their ammonia, and are converted into the basic carbonate and into the cupric hydroxide.

The following are the probable reactions:

(1) $$12(CuSO_4,\ 5H^2O) + 12(Na_2CO_3,\ 10H_2O) = 6\underbrace{[CuCO_3,\ Cu(OH)_2,\ H_2O]}_{\text{Basic carbonate of copper.}} + 12Na_2SO_4 + 6CO_2 + 168H_2O$$

(2) $$6[CuCO_3,\ Cu(OH)_2] + \underbrace{20NH_4HO}_{\text{To dissolve.}} = \underbrace{6(CuCO_3,\ 2NH_3)}_{\text{Ammonio-copper carbonate.}} + \underbrace{2[3Cu(OH)_2,\ 4NH_3,\ 3H_2O]}_{\text{Ammonio-cupric hydroxide.}} + 14H_2O.$$

(3) In drying upon the plant.

$$6(CuCO_3,\ 2NH_3) + 6H_2O = \underbrace{3[CuCO_3,\ Cu(OH)_2]}_{\text{Basic carbonate of copper.}} + 3(NH_4)_2CO_3 + 6NH_3$$

$$2[3Cu(OH)_2,\ 4NH_3,\ 3H_2O] = 6Cu(OH)_2 + 8NH_3 + 6H_2O.$$

From the above formula it is found that to satisfy the reaction, the two pounds of copper sulphate will require 2.3 pounds of crystallized carbonate of soda, which will eventually produce .44 pounds of basic carbonate of copper and .38 pounds of the cupric hydroxide, or a total of .82 pounds of the mixed salts.

AMMONIACAL COPPER CARBONATE.

Formula.—Copper carbonate, 3 ounces; strong ammonia, 1 quart; water, 22 gallons.

In the preparation of this solution, the chemistry is the same as that given under modified eau celeste and the reactions are given in formulæ (2) and (3).

Upon the same basis as before, 3 ounces of copper carbonate will yield 1.5 ounces of basic carbonate and 1.32 ounces of cupric hydroxide, or a total of 2.82 ounces. The difference between the modified eau celeste and the ammoniated copper carbonate consists in the presence of sodium sulphate in the former material, and its absence in the latter. Whether this sodium sulphate will be at all harmful to foliage is a question to be decided by experiment, and the writer would advise that this question be tested. The cost of the copper carbonate in the modified eau celeste is approximately 20 cents per pound, while the cost of the commercial carbonate, is, according to present quotations, 65 cents per pound. Furthermore it is seen from the following table that the cost of the basic salts of copper deposited upon the plant, is, in the modified eau celeste, 29 cents per pound, and in the ammoniacal copper carbonate 94 cents per pound; a difference worthy of serious consideration.

In the use of both the modified eau celeste and the ammoniacal copper carbonate there is not produced continually a basic carbonate of copper, but a mixture of the basic carbonate, and the hydroxide. Would it not therefore be well to try the pure basic carbonate either by precipitating the copper with sodium carbonate, and applying it in suspension as the hydroxide is applied in the Bordeaux mixture or by dissolving this precipitate in ammonium carbonate? By the former method, using 2 pounds of copper sulphate, and 2½ pounds of sodium carbonate, we would have an extremely cheap and perhaps effective fungicide.

The following table has been constructed that the facts contained in this paper might be presented in a condensed form.

The writer in conclusion would particularly recommend that the relative value of the hydroxide, the basic sulphate, and the basic carbonate be tested by the application of materials containing equal weights of these salts per unit of water.

Name of fungicide.	Form of salts when dry upon the plant.	Weight of foregoing salts per 22 gallons.	Weight of original copper salt to make 1 pound of salt when dry on plant.	*Cost of fungicides per 22 gallons.	Cost of 1 pound of copper salt when dry on plant.
		Pounds.	*Pounds.*	*Cents.*	
Bordeaux mixture	Cupric hydroxide, $Cu(OH)_2$	2.34	2.5	34.25	\$0.146
Eau celeste	Basic copper sulphate, $Cu\,SO_4$, $2Cu(OH)_2$.	.47	2.13	21.25	.452
Modified eau celeste	Basic copper carbonate, $Cu\,CO_3$, $Cu(OH)_2$, and Cupric hydroxide, $Cu(OH)_2$.	.82	2.44	24.37	.297
		Ounces.			
Ammoniacal copper carbonate.	Basic copper carbonate, $Cu\,CO_3$, $Cu(OH)_2$, and Cupric hydroxide, $Cu(OH)_2$.	2.82	1.06	16.6	.943

* Wholesale cost of materials from which calculations in the last two columns of the above table were made: Copper sulphate, 5⅜ cents per pound; sal soda, 1¼ cents per pound; strong ammonia (26°), 7 cents per pound; copper carbonate precipitated from copper sulphate by sal soda, 13.87 cents per pound.

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NOTES ON FUNGICIDES AND A NEW SPRAYING PUMP.

BY B. T. GALLOWAY.

In connection with the papers found elsewhere in the JOURNAL, it would seem proper to say something in regard to the preparation of fungicides, particularly those recommended for use. The manner of preparing most of these, however, has been so fully described in former publications that we deem it unnecessary to repeat the descriptions here. We will say, in passing, that the circulars—Nos. 5 and 6 of the Section of Vegetable Pathology—containing this information will be forwarded to all those desiring to consult them.

Aside from the old and well established preventives and remedies, there are several new ones which we think it would be well to call attention to in order that they may be more fully tested. The first of these is a solution of copper acetate or verdigris, which was mentioned in Volume 5, Number IV, of the JOURNAL. It is prepared as follows:

Dissolve 3 pounds of powdered verdigris in 6 to 8 gallons of water and after standing for twenty-four hours dilute to 22 gallons. If desired the amount of verdigris may be increased to 4 pounds without injury to the plants.

This preparation being comparatively cheap and easily prepared, it would be well to test it for downy mildew and black-rot of the grape, making the applications as described for Bordeaux mixture and the other well-known preparations.

Another preparation which might be tried for downy mildew is made as follows:

Dissolve 5 pounds of alum in 3 or 4 gallons of boiling water, and then pour this solution into a half barrel or tub containing sufficient cold water to make 15 gallons. In another vessel dissolve 42 pounds of calcium chloride in 3 gallons of cold water. Finally, pour the calcium chloride solution slowly into the alum preparation, stirring constantly to effect a thorough mixing.

When the two solutions are mixed there is formed aluminium chloride, potassium sulphate, and calcium sulphate. It is claimed that the fungicidal property lies in the first, while the calcium sulphate facilitates its adhesiveness. The potassium sulphate is, as every one knows, a fertilizer and as it is washed from the leaves it enriches the soil.

In addition to what is said here the papers of Professor Goff and Professor Chester should be carefully consulted, as they contain several new and important suggestions in regard to the preparation and application of fungicides. For the benefit of those having in mind the treatment of plant diseases the coming season, we quote below the usual prices of the various chemicals used in the preparation of fungicides. The quotations are for 100-pound lots. In smaller quantities the prices will range from one-fifth to one-third higher, so that money will be saved

if farmers and fruit-growers will club together in making their purchases. Such an arrangement will also save considerable in the way of transportation expenses.

	Per pound.		Per pound.
Copper carbonate	$0.60	Iron sulphate	$0.02
Copper sulphate	.08	Flowers of sulphur	.04
Potassium sulphide	.25	Alum	.03½
Aqua ammonia (22 Beaumé)	.08	Calcium chloride	.06
Sodium hyposulphite	.03	Aluminium sulphate	.05
Copper acetate	.30	Lime per barrel	2.00

NEW SPRAYING PUMP.

Ever since the work of the Section was inaugurated there has been felt the need of a cheap, serviceable, and effective apparatus for spraying grapes and all the low-growing crops. Heretofore we have had to rely mainly upon machines imported from France; in fact, with but one exception, the only pumps that have given satisfaction in our vineyard work have been purchased abroad. The average fruit-grower can not afford to send to France for a machine that will cost him, laid down in this country, all the way from $18 to $25, nor can he pay $21 for a pump made here, notwithstanding the fact that it is a most excellent machine and costs almost the selling price to manufacture it. In short, a knapsack pump, be it ever so serviceable, at $21 or even $18, is entirely beyond the reach of the average farmer, gardener, and fruit-grower. Consequently he has to rely upon inferior machines, and, as a result, his treatments are frequently unsuccessful for the simple reason that the remedies are not properly applied.

We have had the matter of providing a cheap and serviceable knapsack pump under consideration for some time, and can now positively announce that the machine will be on the market in a few weeks. The pumps will be made in two or three styles, and as there will be no patent on them we hope manufacturers throughout the country will be able to offer them at about $12, thus placing them within the reach of all.

PREVENTION OF SMUT IN OATS AND OTHER CEREALS.

By W. A. Kellerman and W. T. Swingle.

The smuts of oats and other plants are minute vegetable parasites. They appropriate for their use the nourishment which the infected plant prepared for its own development, and in this way reduce its vitality or completely destroy the part attacked. The dark-colored powdery mass popularly called the smut is merely the mature fruit of the parasite, and consists of exceedingly minute reproductive bodies

called spores. These, when subjected to proper conditions, germinate by sending out a slender tube upon which small sporidia appear.

The smut arrives at maturity in case of oats when the latter are in bloom, and the spores, blown hither and thither, find their way into the flowers. The husks soon close over the young grain, and the spores which may have been thereby imprisoned remain dormant until the seed is planted in spring. The warmth and moisture cause the spores and the oats to germinate simultaneously. The slender tubes emitted by the spores now penetrate the delicate oat plants. Thereafter the smut plant grows concealed within its host until they both approach maturity. At this time the smut spores rapidly develop in the abortive head of oats and the black mass of smut becomes conspicuous.

It is sometimes claimed that smut in the soil, or in manure applied to the soil, will infect the young oat plants. This is certainly not the usual mode of infection and it may be doubted whether it ever occurs.

If the spores inclosed in the husks of the grain can be killed without injuring the seed, the smut can be perfectly prevented in the crop. This has usually been accomplished by soaking the seed in a solution of blue vitriol (copper sulphate). This process though destroying all or nearly all the smut, also injures the seed more or less. The hot-water method of Professor Jensen has proven thoroughly effectual in preventing smut and, besides, is not in the least injurious to the seed. In fact, both our own and Jensen's experiments show yields greater than would be expected from the mere prevention of the smut. We therefore recommend this treatment, which consists simply in immersing the infected seed in scalding water (132° Fahr.) for not less than five nor more than fifteen minutes, and immediately thereafter cooling it quickly by immersing in cold water.

In order to carry out this process satisfactorily when a large amount of seed is to be treated, two large vessels must be provided. These can be large kettles hung over a fire, or large boilers on a cook-stove. One vessel is to contain heated water (about 110° to 120° Fahr.) for the purpose of warming the seed preparatory to dipping into the second vessel. This second vessel is to contain water at a temperature of 132° to 135° F. Were not the seed warmed before dipping into the vessel of scalding water the temperature of the latter would be very much reduced, perhaps below 130°, and then the treatment would not be effectual. The seed, a half a bushel or more at a time, is to be placed in a coarsely-woven basket having a lining of wire netting with meshes fine enough to prevent the egress of the grains, say, twelve to the inch. A heavy wire bushel-basket may be used, or a light iron frame made over which the wire netting may be stretched. A lid or cover must be provided for, otherwise a portion of the seed will escape upon immersion. A sack made of coarsely woven cloth might be used instead of the basket, but it is much less convenient. It is necessary that the basket admit the water freely and immediately upon its immersion,

otherwise the treatment can not be expected to be effectual. An immersion of a few moments (less than a minute) will sufficiently warm the basket of seed, provided that it be lifted out then plunged in a time or two and shaken or revolved so that the water may come in contact with the grains. Then plunge it immediately into the second vessel, and with similar motion bring every grain into immediate contact with the scalding water. The lifting and plunging should be continued at short intervals until the seed is removed. In this way every portion of the seed will be subjected to the action of the scalding water. Immediately after its removal dash cold water over it or plunge it into a vessel of cold water and then spread out to dry. Another portion can be treated similarly, and so on till all of the seed has been disinfected.

The important precaution to be taken is as follows: *Maintain* the proper temperature of the water (132° Fahr.), in no case allowing it to rise higher than 135° or to fall below 130°. This will not be difficult to do if a reliable thermometer is used and hot or cold water be dipped into the vessel as the falling or rising temperature demands. Immersion fifteen minutes will not then injure the seed, though no doubt in a less time it will be thoroughly disinfected.

The seed can be treated any length of time before sowing. If it is to be stored it would be necessary to have it first thoroughly dried. If treated immediately before using it can be sowed broadcast when dried sufficiently to prevent adhesion of the grains, but for planting with the drill it would need perhaps to be more nearly dry.

The above outline of treatment is for oats, wheat, and rye. Professor Jensen has determined that barley must be previously soaked in cold water eight hours, otherwise the smut is not prevented.

It is to be remembered that this treatment if universal in any section of country will, besides preventing smut in the crop of the season, also insure clean seed for use the following year. It has been established by actual count that the smut often destroys a very large percentage of the crop. When the smut was reported to be inconsiderable or even absent, we have determined that there may be 5 to 15 per cent. of the heads smutted. These are at harvest time usually overlooked because the smut has been blown away and the inconspicuous naked and clean stalk only remains. It might be added in this connection that it has been established recently that the smuts of barley and wheat, though much resembling that of oats, are really different species.

Finally we may mention by way of suggestion for the benefit of others that farther experimentation is now being prosecuted, or about to be undertaken, having in view the determination of numerous points in connection with the application of fungicides for the prevention of smut. Among these are the following: A comparison of the efficacy under varying conditions of the hot-water treatment with other fungicides; comparison as to increase of yield when this or any other fungicides are used; trial of the Jensen method with other plants besides oats and

wheat, as barley, rye, grasses, millet, and maize; and the determination of the most favorable form of treatment, particularly with reference to the degree of temperature required, the duration of the immersion in hot water, and the mode of cooling.

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OBSERVATIONS ON THE DEVELOPMENT OF SOME FENESTRATE SPORIDIA.

(Plates I & II.)

BY CHARLES E. FAIRMAN.

The following notes have been made on the development of the sporidia in *Fenestella amorpha*, E. & E.,* and in *Patellaria fenestrata*, C. & P.,† A few comparisons have been made with the spore development of *Camarosporium subfenestratum*, B. & C.

In *Fenestella amorpha* we find the first stage of sporidial development to be represented by the formation of a finely granular protoplasmic layer, in the interior of the ascus. Numerous spherical drops may also be seen a little later in this condensed protoplasmic layer. This layer was not seen to impinge upon the walls of the ascus at any point.

A light-colored homogeneous fluid occupied the space between this layer and the walls of the ascus. Also it was noted that the granular layer did not touch the walls of the ascus at the top or apex. At first this layer appears quite homogeneous. We have designated it the *Sporidiogenic layer* (Fig. 1, plate I).

The sporidiogenic layer is generally broader at the apex of the ascus and narrows somewhat towards the base. In *Patellaria fenestrata* the same general characteristics of this layer will be found to exist. In this species the sporidiogenic layer is at times continuous with the base of the ascus, a condition of affairs which was not made out in the case of *Fenestella* (Fig. 14, plate II).

The next feature observed in the development was the formation of larger spherical bodies in the interior of the sporidiogenic layer. These spherical bodies are the first indications of the forming sporidia (Figs. 2, 3, and 4, Plate I, and Figs. 15 and 16, Plate II). In *Fenestella amorpha* the number generally found was 8, and in *Patellaria fenestrata* 4 (although more may be occasionally seen in the latter). As mentioned above, the general outline is spherical, and they seem to be placed at nearly equal distances apart, in number corresponding to the sporidia commonly found in the ascus of the species under consideration. They are the forming or immature sporidia. Nuclei next make

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*Journ. Mycol., Vol. IV, p. 58. †28th Report N. Y. State Mus., p. 68.

their appearance in the primitive sporidia (Fig. 2, Plate I, and Fig. 15, Plate II).

In *Fenestella amorpha*, with the appearance of the nuclei in the immature sporidia, the sporidiogenic layer begins to lose its distinctness of outline and to be either absorbed or resolved.

In *Patellaria fenestrata* the sporidiogenic layer persists longer. (See Fig. 16, Plate II.) Our observations will not warrant a definite answer to the question how long it does remain. It has been suggested that it persists to the full development of the sporidia and forms a mucous coating to the sporidia (of *Patellaria*). Peck, in 28th Rep. N. Y. State Museum, page 68, says of this species: "Asci subclavate, spores four to eight *involved in mucus*, large pyriform," and gives later as one of the points of distinction between this species and *Patellaria dispersa*, Ger., that "the spores are longer in proportion to their breadth and involved in mucus." The nuclei increase in number, but this increase is variable in different species and probably in the same species. The number of separate divisions in the matured sporidia corresponds closely with the number of nuclei formed during the process of segmentation of the sporidia.

In *Fenestella amorpha* from 5 to 7 nuclei form inside the sporidia, in *Patellaria fenestrata* 7 or more, in *Camarosporium subfenestratum* spores from 4 to 7. (Fig. 19, Plate II.)

The nuclei now enlarge and fill up the sporidia. Some of them subdivide into two or more. In *Fenestella amorpha* the majority subdivide. In *Camarosporium subfenestratum*, as far as observed, the nuclei do not all subdivide. Generally a few near the middle of the spore subdivide.

Up to the commencement of this stage the sporidia of *Fenestella amorpha* are hyaline or subhyaline; but with the subdivision of the contents of the sporidia we find a decided darkening in color. In *Patellaria fenestrata*, and in *Camarosporium subfenestratum* also, the same change of color becomes noticeable. As the development of the sporidia progresses the color gradually darkens.

With the increase in size of the divisions of the sporidia and the changes in the secreted cell walls we now have in *Fenestella amorpha* very dark-colored sporidia, whose *transverse septa* correspond to the limits of the first formed nuclei, and the *longitudinal septa* to one or more of the subdivisions of the same.

In *Fenestella amorpha* the longitudinal septum is irregular; where the subdivisions number three the longitudinal septum runs between them, so that we have one on one side and two on the other, and where the subdivisions are four, two will be found on each side of the septum.

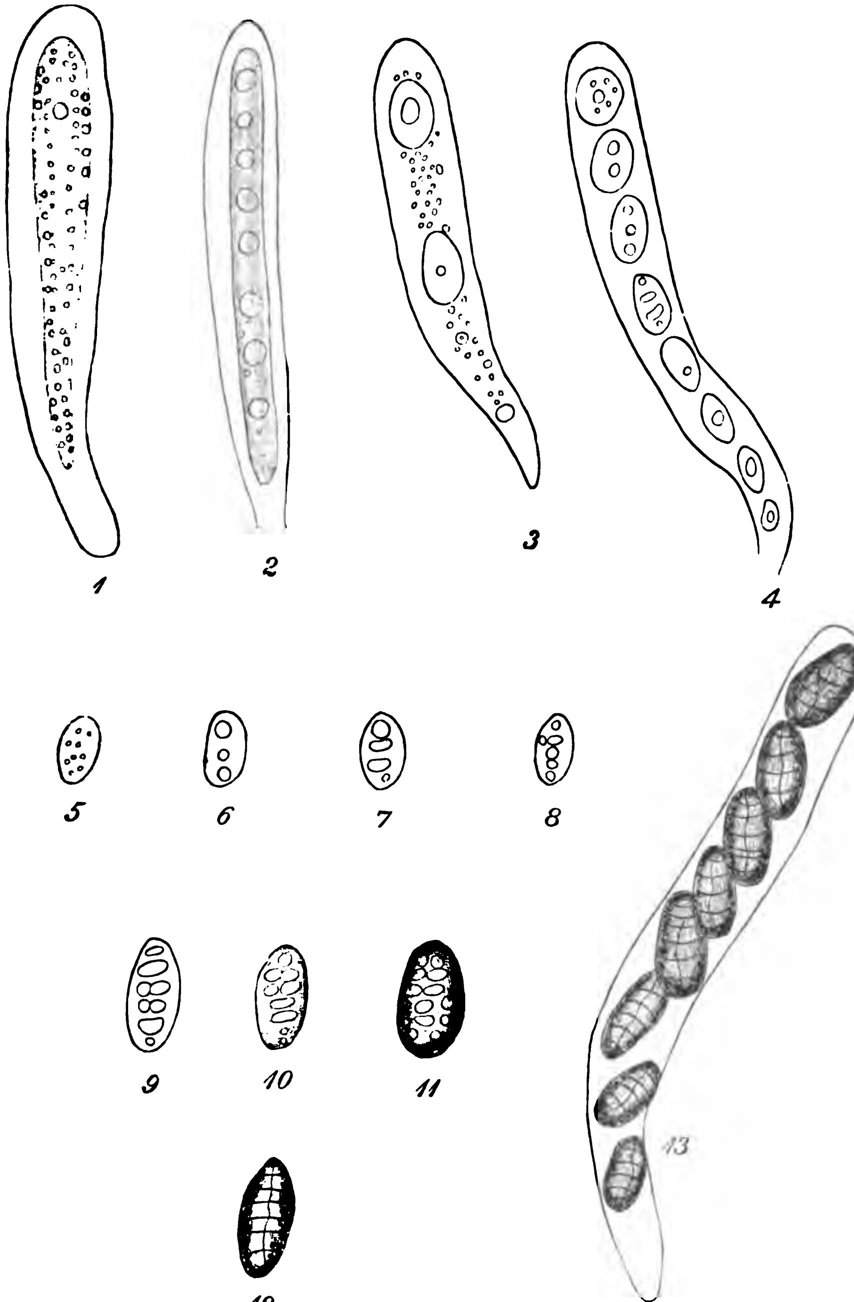
To recapitulate.

The development of fenestrate sporidia may be divided into three stages, viz:

First. The formation of the sporidiogenic layer.

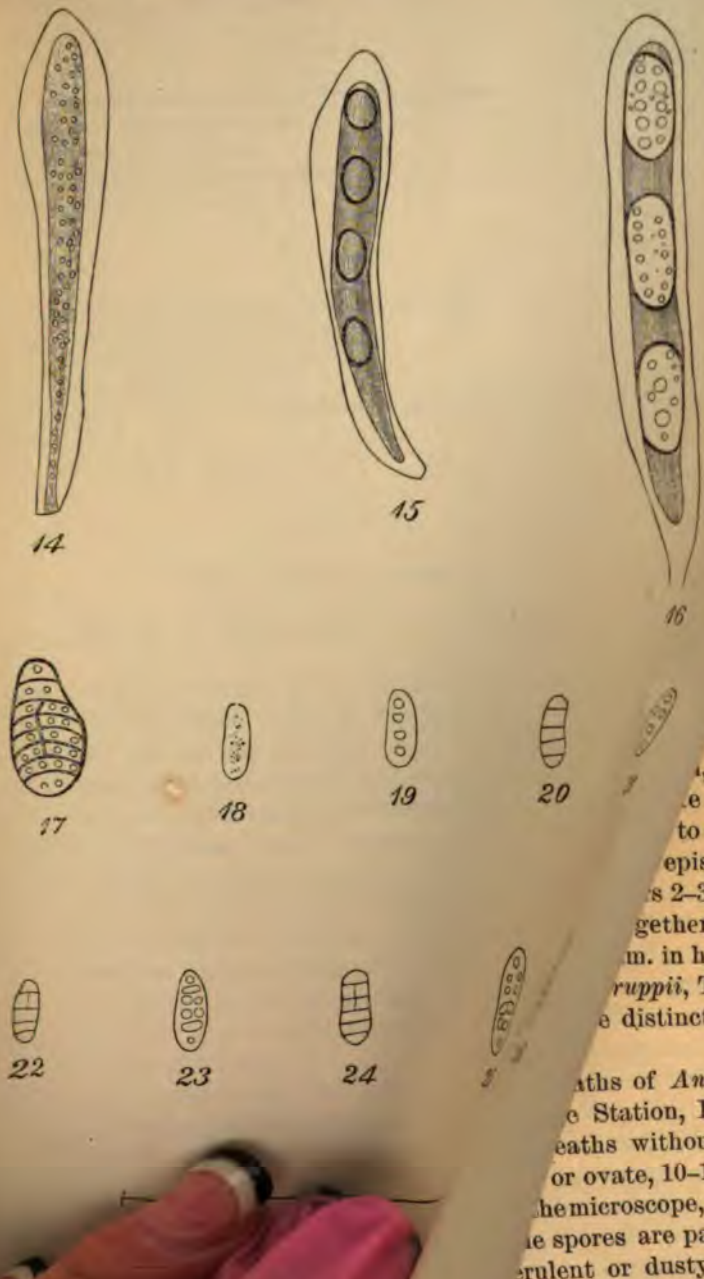
Second. The segmentation of the immature sporidium.

Third. The maturation.



C. E. FAIRMAN, DEL.

FAIRMAN ON DEVELOPMENT OF SPORIDIA.



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EXPLANATION OF PLATES.

PLATE I.

FIGS. 1 to 13. Development of sporidia of *Fenestella amorpha.*
1. Formation of sporidiogenic layer.
2, 3, and 4. Primitive sporidia.
5–12. Stages in sporidial development.
13. Mature ascus and sporidia.

PLATE II.

FIGS. 14–17. Sporidial development of *Patellaria fenestrata.*
14. Formation of sporidiogenic layer.
15–16. Formation of primitive sporidia.
17. A nearly developed sporidium.
18–26 represent stages in development of spores of *Camarosporium subfenestratum.*

The scale applies to both plates.

NEW SPECIES OF FUNGI.

BY J. B. ELLIS AND B. T. GALLOWAY.

ÆCIDIUM CREPIDICOLUM, *n. s.* On leaves of *Crepis acuminata*, Helena, Mont., June, 1889. Rev. F. D. Kelsey, No. 98. Amphigenous, small, clustered but not crowded, often subcircinate around a vacant space in the center, hemispheric and closed at first, soon open, peridium thin, white, margin narrowly reflexed, at length lacerate cleft nearly or quite to the base. Spores subglobose, 20–24μ, varying to ovate and elliptical, 20–30 by 15–20μ (smooth ?) with a rather thick epispore. The leaf is slightly thickened in the affected spots. Clusters 2–3 milimeters in diameter, few on a leaf, or smaller (3–6 æcidia together) and then more numerous. Differs from *Æcidium crepidis*, Thüm. in having the æcidia mass deeply buried in the leaf. *Æcidium Rostruppii*, Thüm. has the æcidia larger, but possibly our plant may not be distinct from *Æcidium Barkhausiæ*, Roum.

USTILAGO (SOROSPORIUM ?) BRUNKII, *n. s.* In sheaths of *Andropogon argenteus*, destroying the inflorescence. College Station, Brazos County, Tex. H. S. Jennings. Inclosed in the sheaths without any distinct membranaceous covering. Spores globose or ovate, 10–18μ, in diameter, often apiculate, olivaceous brown under the microscope, finally subopaque. Epispore smooth, thick (3–4μ). The spores are partially agglutinated and hence are not as loosely pulverulent or dusty as in most species.

SOROSPORIUM ELLISII, Winter, var. PROVINCIALIS, *n. var.* In inflorescence of *Andropogon provincialis.* Saline County, Mo. (Demetrio), and Custer County, Nebr. (Webber). Differs from the original speci-

mens on *Andropogon Virginicus*, described by Dr. Winter in Bull. Torr. Club, X p. 7, and distributed in N. A. F., 1099, in its more regular-shaped spores, with a thicker epispore and its larger spore glomerules subglobose, 35–150 μ, or oblong, 100–200 by 75–80 μ. The cylindrical mass of spores, also with an elongated bundle of fibers (the remains of the enveloping sheath)?, is inclosed in a light-colored membranaceous sack, which protrudes above, while in the typical form this sack is less distinct and is entirely concealed.

SOROSPORIUM EVERHARTII, *n. s.* In florets of *Andropogon Virginicus.* Newfield, N. J., October (N. A. F., 2265 b.). Glomerules compact, opaque, 50–120 μ, in diameter, globose or oblong, composed of 100–300, or more closely-compacted spores, which do not easily separate and vary from subhyaline to brown and from subglobose 8–10 μ in diameter to oblong, 10–12 by 8–10 μ, with a nearly smooth epispore of medium thickness. The tips of the glumes in the affected florets become bleached, and open in a bifid manner, the lobes more or less reflexed, allowing the subcylindrical mass of spores to protrude. This differs from *S. Ellisii*, Winter in its smaller spores, more compact glomerules, and in attacking single florets instead of involving the entire inflorescence.

DIDYMOSPHÆRIA DENUDATA, *n. s.* On bark of dry dead oak limbs from which the epidermis had fallen off. Newfield, N. J., March, 1889. Perithecia scattered, ovate, suberumpent, minute (one-quarter millimeter), with comparatively thick membranaceous walls, the erumpent apex (about one-third part) roughish, black, with a papilliform ostiolum. Asci cylindrical, about 50 by 7 μ, abruptly contracted below into a short stipe-like base. Sporidia 1-seriate, elliptical, 1-septate, brown, 6–7 by 4 μ. This differs from *D. cupula*, E. & E., in its perithecia not collapsing and smaller, and in its smaller sporidia and shorter asci. It is found on the upper exposed side of the limb which is usually more or less bleached.

OPHIONECTRIA EVERHARTII, *n. s.* On old *Diatrype stigma* and on the decaying bark of oak limbs. Newfield, N. J., January, 1889. Gregarious, Perithecia ovate-globose, about one-sixth millimeter in diameter; granular-pruinose, except the rather acutely papilliform ostiolum dull dirty-yellow. Asci oblong-cylindrical, 75–80 by 12–14 μ, with rather indistinct paraphyses. Sporidia crowded-biseriate, fusoid, yellowish-hyaline, nucleate becoming faintly multiseptate, straight while lying in the asci, curved when free, 35–50 μ long and 3–3½ μ thick in the middle, gradually tapering towards each end.

GLŒOSPORIUM PALUDOSUM, *n. s.* On leaves of *Peltandra Virginica.* Virginia, August, 1889. D. G. Fairchild; Wilmington, Del., October, 1889. A. Commons, No. 977. Spots amphigenous, orbicular, or elliptical, ½–1 centimeter in diameter or by confluence larger, dirty brown, subzonate; margin darker and subindefinite. Acervuli minute (65–75 μ), mostly erumpent above. Spores oblong, granular, 18–22 by 6–7 μ.

CERCOSPORA BRUNKII, *n. s.* On leaves of geranium (cult.). Brazos County, Tex., November, 1889. Prof. T. L. Brunk. Spots amphigenous, light-brownish or pale brick color, orbicular or oval, ¾–2½ millimeters in diameter, with a narrow, slightly raised, and rather darker border, which is more prominent on the lower side of the leaf. Hyphæ amphigenous, but more abundant below; pale brown, 90–200 by 3–5μ, subgeniculate, 2–5 septate, forming loose spreading tufts of 5–6 (rarely more). Conidia clavate-cylindrical, hyaline, multiseptate (5–20). 50–125μ. long, 3–4μ. thick (at the lower end). Differs from *C. geranii* in its darker hyphæ with more numerous septa, its larger multiseptate conidia and the raised border of the spots.

DENDRODOCHIUM SUBEFFUSUM, *n. s.* N. A. F. 394. On thallus of some foliaceous lichen on trunk of a pear tree. Farmington, N. Y., August, 1889. E. Brown, 134. Sporodochia subeffused, spreading over parts of thallus and apothecia, collected and condensed here and there into compact orange-red subapplanate masses about 1 millimeter in diameter. Basidia subulate, 25–35 by 2–3μ, sparingly branched. Conidia terminal, solitary, subglobose to ovate and elliptical hyaline 1–2 nucleate, 5–8 by 4½–6μ.

SCORIOMYCES ANDERSONI. *n. s.* Under a decaying log of *Pinus ponderosa*. Belt Mountains, Montana. Altitude 6,500 feet. September, 1889. F. W. Anderson. Forms a waxy-yellow porous mass, 4–12 centimeters long, 2–4 centimeters thick and 2–4 centimeters wide, with an irregularly lobed outline and uneven, colliculose surface; lying among the decaying wood and humus and resembling somewhat a mass of collapsed honeycomb. It is made up principally of loosely compacted globose spores, 35–55μ in diameter and filled with coarse granular matter. Differs from *S. Cragini*, S. & E., in its more compact growth and larger spores. In *S. Cragini* they are only 18–20μ in diameter.

NEW FUNGI.

BY J. B. ELLIS AND B. D. HALSTED.

PHYLLOSTICTA MOLLUGINIS, *n. s.* On *Mollugo verticillata.* New Brunswick, N. J., October, 1889. Perithecia amphigenous, scattered, black, prominent, 80–100μ in diameter. Sporules oblong or elliptical-oblong, hyaline, 8–10 by 3–4μ.

SEPTORIA RUDBECKIÆ, *n. s.* On leaves of *Rudbeckia laciniata*, northern New Jersey, September, 1889. Halsted. On *R. hirta*, Wilmington, Del., October, 1889. Commons, 1033. Spots conspicuous, of a weather-beaten or wood-colored brown, 2–4 millimeters in diameter, irregular, subangular in outline, with a definite darker border surrounded by a purplish stain. On *R. laciniata*, often one or two smaller white spots are included in the larger brown spots. On both hosts the spots are paler below. Perithecia epiphyllous, prominent, subacute, black, scat-

tered. Sporules filiform nearly straight, multinucleate, 30–60 by 1½–2μ about the same as in *S. helianthi*, E. & K., to which this is closely allied.

GLŒOSPORIUM CLADOSPORIOIDES, *n. s.* N. A. F., 2438. On living stems and leaves of *Hypericum mutilum*. Metuchen, N. J., July, 1889. Acervuli subcuticular, nearly black, about 35μ in diameter, superumpent, gregarious. Hyphæ fasciculate, continuous, toothed above, hyaline, becoming brown. Spores oblong, hyaline, faintly nucleolate, 10–14 by 3½–4½μ. Very injurious to the host plant.

CYLINDROSPORIUM IRIDIS, *n. s.* On *Iris versicolor*. Iowa City, Iowa, June, 1887. A. S. Hitchcock. Acervuli very minute and very numerous, subcuticular, blackish, forming continuous series or strips between the nerves of the leaf for several centimeters in length, the exuded spores appearing like a white tomentum on the matrix. Spores acicular, 15–22 by 1μ. Hyphæ short, subhyaline, mostly toothed above, 8–10 by 2μ.

ZYGODESMUS PYROLÆ, *n. s.* On petioles of *Pyrola rotundifolia*. New Brunswick, N. J., July, 1889. Forming a reddish-gray, thelephoroid layer enveloping the lower part of the petiole, which is slightly enlarged and distorted, and finally killed. Hyphæ, reddish-brown, much branched, the branches often issuing at a right angle, divided at their extremities into numerous short, obtuse arms bearing the subglobose, 8–10μ, rather coarsely spinulose-roughened, subhyaline, or reddish-brown conidia. The hyphæ are 3–4μ thick, and show the zygodesmoid joints very distinctly. The general appearance is something like that of *Calyptospora Gœppertiana*.

CERCOSPORA LYSIMACHIÆ, *n. s.* N. A. F., 2475. On *Lysimachia stricta*. Jonesburgh, N. J., July, 1889. B. D. H. Spots, none; tufts, effused, covering the lower, less abundantly the upper surface of the leaf, which soon becomes of a dark red and dries up. Hyphæ in dense, spreading tufts, subundulate, subentire, reddish-brown, continuous, 40–50 by 4μ. Conidia, slender, obclavate, multinucleate (becoming septate), rusty-brown, 50–80 by 3μ. Under the hand lens this resembles *C. lythri*, West (specc. in Kunzes F. Sel., 594), but that has longer, slenderer, less densely tufted hyphæ and shorter, broader conidia.

CERCOSPORA CLEOMIS, *n. s.* On *Cleome pungens*. New Brunswick, N. J. Spots amphigenous, suborbicular, gray with a narrow dark border, 2–4 millimeters in diameter. Hyphæ amphigenous, loosely tufted, pale brown, septate, geniculate, 75–110 by 3½–4μ. Conidia slender, hyaline, multiseptate, 75–100 by 3–3½μ. Differs from *Cercospora capparidis*, Sacc. in the character of the spots and in its longer conidia and septate hyphæ.

COLLETOTRICHUM SPINACIÆ, *n. s.* On living leaves of spinach, which is much injured by it. Newark, N. J., February, 1890. Maculicolous. Spots round, dirty whitish or greenish, 2–4 millimeters in diameter, with a slightly raised border. Acervuli amphigenous, punctiform, 40–75μ in diameter, clothed with a few (3–12) erect or spreading bristle-like hairs,

60–75 μ long and 4–4½ μ thick at the sub-bulbous base, subhyaline and subacute above, dark brown below, continuous (or faintly septate?). Conidia subfalcate-fusoid, hyaline, 2–4 nucleate, 14–20 by 2½–3 μ, ends subacute, basidia short.

NEW SPECIES OF LOUISIANA FUNGI.

BY J. B. ELLIS AND A. B. LANGLOIS.

OIDIUM OBDUCTUM, *n. s.* On living leaves of young *Quercus* (*falcata?*). St. Martinsville, La., May, 1889. Langlois, 1708. Hypophyllous. Sterile hyphæ, slender (3–4 μ thick), sparingly septate, branched, loosely interwoven and with the large (35–50 by 18–22 μ) barrel-shaped conidia forming a thin continuous or partially interrupted cinereous white layer over the greater part or often over the entire surface of the leaf. The concatenate conidia are formed by the constriction of the fertile hyphæ, rather abruptly contracted at each end and truncate.

OVULARIA MACLURÆ, *n. s.* On living leaves of *Maclura aurantiaca.* St. Martinsville. Hypophyllous on rusty brown round spots, 3–5 millimeters in diameter. Prostrate hyphæ branching, erect (fertile); hyphæ simple or sparingly branched above, slender, 15–22 by 2½–3 μ, continuous, hyaline. Conidia subcatenulate, oval, hyaline, continuous, 6–9 by 2½–3 μ.

DACTYLARIA MUCRONULATA, *n. s.* On decorticated and decaying wood of *Carya.* St. Martinsville, La., May, 1888. Langlois, No. 1220. Prostrate sterile hyphæ obsolete or wanting, fertile hyphæ erect, 35–40 by 3½ μ, continuous or with 1–2 faint septa and brown below, more or less angularly bent, and subhyaline above with terminal and lateral mucronulate teeth bearing the oblong 2-nucleate, hyaline, 8–10 by 2½–3 μ, conidia. The fertile hyphæ appear like a dull-purplish, velvet-like pubescence on the surface of the wood. *D. purpurella*, Sacc., has larger conidia and subspathulate-pointed hyphæ.

CONIOSPORIUM MYCOPHILUM, *n. s.* Parasitic on pileus of *Polyporus pergamenus*, (Fr.) and *Lentinus ursinus*, (Fr.). Louisiana, May, 1888. Langlois, 1306. Forms thin olive-black spots, scattered or confluent about 1 millimeter diameter. Conidia elliptical, olive-black, smooth, about 8 by 4 μ.

HORMODENDRUM DIVARICATUM, *n. s.* On rotten wood. St. Martin's County, La., May, 1888. Langlois, No. 1292. Forming loose, scattered tufts, fertile hyphæ, soon opaque, erect or spreading, 80–150 by 4–5 μ; divaricately branched, the few branches often issuing at right angles, and like the upper portion of the main hyphæ articulated and constricted, separating into subelliptical, or lemon-shaped, opaque conidia, 7–12 by 6–7 μ, the lower ones being the longer, the upper and terminal ones often subglobose.

CERCOSPORA ALTERNANTHERÆ, *n. s.* On leaves of *Alternanthera achyrantha.* St. Martinsville, La. Langlois, No. 1430. Maculicolous. Spots round, 1–2 millimeters in diameter; dirty brown, with a whitish center and shaded brown border; hyphæ, 25–30 by 5μ, continuous, olivaceous, truncate above, arising from a tubercular base about 25μ in diameter; conidia obclavate, hyaline 1–3 septate, 65–80 by 3μ.

CERCOSPORA THALIÆ, *n. s.* N. A. F., 2426. On living and dead leaves of *Thalia dealbata.* St. Martinsville, La., October, 1889. Hyphæ amphigenous, very short, ovate, 6–8 by 5 μ, olivaceous, mostly protruding in fascicles of 6–15 from the stomata of the leaf. Conidia cylindrical, olivaceous, 3–8 septate, 50–100 by 6–8 μ. Ends rounded and obtuse. The hyphæ form dense, slaty-black, narrow, elongated patches 1½–2 millimeters wide and 3–5 millimeters long between the veinlets of the leaf in the same manner as in *C. zebrina*, Pass.

MACROSPORIUM CAROTÆ, *n. s.* On living leaves of *Daucus carota*, to which it is very injurious. St. Martinsville, La., June, 1888. Langois, No. 1327. Turning the leaves yellow, then brown black, and killing them entirely. Sterile hyphæ erect, at first simple, straight, brown, and septate, finally somewhat branched above, and 80–100 μ high by 4–6μ thick. Conidia clavate, brown, 5–7 septate, with one or two of the upper cells divided longitudinally, 55–70 by 12–14μ, on long, slender (1½–2μ thick), permanent pedicels 80–110μ long.

GRAPHIUM SQUARROSUM, *n. s.* On dead stems of *Sambucus.* St. Martinsville, La., July, 1888. Langlois, 1381. Cinereous gray, stripes ¾–1 millimeter high and about 20 μ thick; erect, straight; composed of closely compacted fibers, with their hyaline free ends densely spiculiferous and spreading on all sides nearly at right angles below and obliquely upwards above, 8–12 by 2½–3μ, nearly straight or acutely and sharply bent, with their apices dentate and subobtuse. Conidia borne on the spiculiferous ends of the spreading fibers, ovate-oblong, hyaline, continuous, 5–7 by 2–2½ μ. Some of the conidia are larger (10–11 μ long) and 2–3 nucleate. It is uncertain whether these belong to the *Graphium* or are accidental.

SPHAERIDIUM LACTEUM, *n. s.* On decaying herbaceous stems. St. Martinsville, La., January, 1888. Milk white, minute (¼–½ millimeter in diameter), contracted at base so as to appear briefly substipitate. Sporophore branched in a dendroid manner above, the branches moniliform, constricted, and separating into elliptical hyaline, 5 by 3μ, conidia.

PHYLLOSTICTA VIRENS, *n. s.* On living leaves of *Quercus virens.* Louisiana, February, 1887. Langlois, No. 1070. Spots amphigenous, 1 centimeter in diameter, pale grayish-brown, subirregular, definitely limited by a slightly darker line. Perithecia partly erumpent, small (75–100μ.) Sporules oblong-elliptical or subovate elliptical or subfusoid, hyaline, 4–7 by 1½–2½μ. Differs from the other species on oak leaves in the character of the spots and size of the sporules.

VERMICULARIA DISCOIDEA, *n. s.* On dead culms of *Panicum proliferum.* Pointe a la Hache, La., February, 1887. Langlois, 1041. Perithecia for some time covered by the epidermis, discoid, ½–1 millimeter in diameter, orbicular or subelliptical, rather thickly and evenly covered with straight continuous black bristles 79–80 by 4–5μ, and subbulbous at base. Sporules falcate with attenuated acute ends, 3–4 nucleate, hyaline, 35–40 by 5μ. This seems to be quite distinct from any described species.

HAPLOSPORELLA TINGENS, *n. s.* On dead culms of *Andropogon muricatus.* St. Martinsville, La., March, 1889. Langlois, 1783. Perithecia subcespitose, 2–3 together or densely crowded, often seriately erumpent, becoming nearly superficial, conical, about one-third millimeter in diameter and one-half millimeter high. Sporules oblong-elliptical, 18–20 by 9–11μ. The culm is tinged slaty-black within.

DIPLODIA BAMBUSÆ, *n. s.* On dead stems of *Bambusa.* Mostly near the nodes. Perithecia hemispheric one-third to one-half millimeter in diameter, papillate. Sporules elliptical, brown, 1–septate and slightly constricted, 15–20 by 8–10μ.

DIPLODIA CUCURBITACEÆ, *n. s.* On dead pumpkin-vines. Pointe a la Hache, La., March, 1887. Langlois, No. 1049. Perithecia innate-erumpent scattered, their apices projecting and covered with the blackened epidermis. Sporules elliptical, brown, 1 septate, 20–25 by 10–12μ.

BOTRYODIPLODIA VARIANS, *n. s.* On dead limbs of *Lagerstrœmia.* St. Martinsville, La., January, 1889. Langlois, 1784. Perithecia erumpent superficial, solitary, oftener connate in clusters of 2–4 or more, conical, rough except the obtusely conic ostiolum, about one-half millimeter in diameter and a little more than that in height. Sporules elliptical, brown mostly continuous, some of them 1–septate, not constricted, 15–22 by 8–11μ. This may be the *Diplodia lagerstrœmiæ*, Speg., but that is said to have "sublenticular" perithecia only 200–250μ in diameter.

HENDERSONIA TINI, *n. s.* On dead spots in living leaves of *Viburnum tinus.* Lafayette, La., December, 1887. Spots large (2–3 centimeters), cinereous with a purplish-red border. Perithecia amphigenous, punctiform, innate-erumpent. Sporules fusoid, nucleolate, nearly straight, pale straw-yellow, 22–27 by 2½μ. Approaches *Septoria.* Probably the stylosporous stage of *Leptosphaeria tini*, E. & E.

PROSTHEMIELLA HYSTERIOIDES, *n. s.* On decorticated wood of *Salix nigra.* Near New Orleans, La., September, 1886. Langlois, 1792. Acervuli scattered, minute, punctiform or hysteriiform, covered above by a spurious perithecium, tinging the wood of a reddish color. Conidia in threes, cylindrical, hyaline, nucleate and imperfectly 5–6–septate, 30–35 by 1½μ, arising from short cylindrical basidia.

REVIEWS OF RECENT LITERATURE.

GIARD, ALFRED. *Sur quelques types remarquables de champignons entomophytes.* Bulletin Scientifique de la France et de la Belgique, 1889; pp. 197–224. Three plates.

This articles comprises a series of notes on a number of species of entomogenous fungi the greater part of which have already been published in a communication to the Société de Biologie, and which are here republished in a fuller form and with the addition of notes.

Of the nine species mentioned eight are species named and described by himself, and four of these represent new genera. Over half of the article is devoted to the three species *Entomophthora saccharina*, Giard, *E. plusiæ*, Giard, and *E. calliphoræ*, Giard, all of which are illustrated. He has made many trials in germinating both the resting spores and conidia of *E. saccharina* and finds that the latter lose their power of germination very rapidly and by September 1 it is impossible to infect insects with them; the resting spores would not germinate either in the insects or any artificial substratum, and moreover, before spring the bodies of the infested insects containing the resting spores had become covered with the sand of the dune on which he found them. He does not attempt to answer the question as to what becomes of the resting spores or how the caterpillars are infected in the spring.

E. plusiæ came to the author's notice in 1888 on some caterpillars of Plusia gamma which were destroying a field of trefle and luzerne. He did not find the resting spores but thinks it possible that they may appear on the autumn generation of the insect, and suggests that it may be the conidial form of *E. megasperma*. Attempts to inoculate any form of Sylpha opaca failed entirely, but the author believes that the inoculation of Plusia is particularly favored by an Acridien which reproduces on the infested insects.

During the researches on *E. calliphoræ* two forms of resting spores were found, recalling both by this fact and a remarkable similarity of spores the *Basidiobolus ranarum* of Eidam. The infested Diptera were discovered to be filled with resting spores and Giard is inclined to think that the following is the history of the fungus. The resting spores are eaten with the Diptera by Batrachians. They germinate in the digestive tube and produce conidia and some resting spores on the excrementa. Here they are eaten by the Calliphora, in the bodies of which they produce resting spores incapable of germination without a change of host. The experiments necessary to demonstrate this hypothesis have not been made.

The other species described or noted are *E. forficulæ* on Forficula auricularia: *E. Fresenii*, Now., which he has transferred from the genus *Triplosporium* and considers as probably identical with *Neozygites aphidis*, Witz., *Chromostylium chrysorrheæ* Giard, *Epichlœa divisa*, Giard, *Halisaria gracilis*, Giard, and *Polyrhizium leptophyei*, Giard.

The article closes with some general observations, among which the following facts of general interest are brought out:

(1) The use of entomogenous fungi in combatting injurious insects can not be of any injury to man except as they may infect useful insects such as the silk-worm.

(2) No reliable means have yet been ascertained by which injurious insects can be combatted by *Entomophthoreæ*. The question is a more difficult one than has been supposed.—E. A. S.

MASSEE, GEORGE. *A Monograph of British Gastromycetes.* Annals of Botany, November, 1889, Vol. IV., No. XIII, pp. 1–103. Four double plates.

This monograph, which may well be used as a hand-book for collectors of British fungi, is also of interest to American students of this group.

The work contains a discussion of the group in general and of the families comprising it, which is much more readable than De Bary's description of the same as found in the translation of his Morphology and Biology of Fungi. There are also chapters on Affinities and Distribution. A table is added giving the entire list of genera, distinguishing the British ones and noting the entire number of species and numbers of British species.

Mr. Massee divides the *Gastromycetes* into the following families: *Hymenogastreæ*, *Sclerodermeæ*, *Nidularieæ*, *Podaxineæ*, *Lycoperdeæ*, and *Phalloideæ*. The first corresponds, as regards the genera included, almost exactly to Saccardo's descriptions of the same. He includes the genus *Sphanchnomyces* under *Hymenogaster*, and says that a specimen of *Pompholyx sapidum* found near Chichester is evidently a species of *Scleroderma*. He differs from Saccardo in considering the *Sclerodermeæ* as one of the primary divisions of the *Gastromycetes*, and includes in it the following genera: *Polygaster*, *Scleroderma*, *Polysaccum*, *Arachnion*, *Scoleciocarpus*, *Paurocotylis*, *Ciliciocarpus*, *Lycogalopsis*, *Glishroderma*. These are all included in Saccardo's sub-family *Sclerodermeæ* of the *Lycoperdeæ*, but do not comprise all of the genera that Saccardo assigns to the sub-family; the others are placed in the *Lycoperdeæ*.

Massee says that the *Sclerodermeæ* occupy an intermediate position between the *Hymenogastreæ* and *Lycoperdeæ*, differing from the former in not being subterranean and from the latter in the absence of the capillitium and the indehiscent peridium. The genera included in the *Nidularieæ* are the same as those of Saccardo's Sylloge.

In his table of genera he ranks the *Podaxineæ*, which Saccardo regards as a sub-family of the *Lycoperdeæ*, as a family of equal value with the latter. It contains no British genera, however. His *Lycoperdeæ*, therefore, include considerably fewer genera than Saccardo's family of the same name. He characterises it by the constant presence of a capillitium produced from the hyphæ of the trama or peridium and remaining mixed with the spores after the deliquesence of the tramal and hymenial elements. Winter's family *Tulastomei* is placed as a genus

(*Tulastoma*) under the *Lycoperdeæ*. Much attention is given in this, as in others of Mr. Massee's articles, to synonyms and references to literature, and a complete Bibliography is appended, besides the very full references in the description of species.

The plates are excellent, both from an artistic and a scientific point of view.—E. A. S.

WAGER, HAROLD W. T. *Observations on the Structure of the Nuclei in Peronospora parasitica, and on their behaviour during the formation of the Oospore.* Annals of Botany, November, 1889, pp. 127–146. One double plate.

The fact that even the general occurrence of nuclei in fungi has been and is disputed, and that only two observers have ever made any attempt to investigate the phenomena of karyokinesis, even where the presence of nuclei was unquestioned, renders this paper unusually interesting.

The best results were obtained by imbedding the material in paraffine and cutting ribbon sections with a Cambridge microtome. By means of this process, the details of which are given, nuclei were found and their division watched in every portion of the fungus.

In the hyphæ.—The nuclei are most numerous where the hyphæ appear to be completely full of protoplasm, and in well stained sections the chromatin can be seen to arrange itself into threads, which are arranged in the equatorial plane, and which finally separate into two groups, the divisions moving to the opposite poles of the nucleus. Neither the spindle nor the longitudinal splitting of the chromatic elements were observed.

In the oogonium and antheridium.—Large numbers of nuclei are present in both oogonia and antheridia; in the former they become arranged in a layer in the periplasm, and all, with those of the antheridium, pass simultaneously through the karyokinetic processes; two (or three?) of the nuclei of the oogonium then pass into the center, and a wall is formed, shutting out the periplasmic nuclei which rapidly divide into smaller ones. At the same time an antheridial tube is developed, into which some of the nuclei of the antheridium pass. Of these one probably passes into the oospore; the remainder seem to pass into the periplasm of the oogonium, when the antheridial tube becomes disorganized. The ripe oospore contains several nuclei, and its endo- and exo-spore are formed from the periplasm and nuclei contained in it.

In the gonidia.—The nuclei of the gonidia are larger than those of other portions of the fungus, and differ in structure. There are a large number in each spore, but neither their division nor their origin has been observed.—E. A. S.

WARD, H. MARSHALL. *Timber and Some of its Diseases.* 8mo., 295 pages. Macmillan & Co.

The author, in this little volume, although treating the subject in a somewhat popular way, will especially interest the readers of this

JOURNAL, by his descriptions of the various diseases to which our forest and fruit trees are subject. Of the thirteen chapters, seven are devoted to the descriptions of the modes of growth of specific fungi which have, from their abundance and destructive nature, attracted the attention of tree growers.

Those which receive considerable attention, are the following: *Trametes radiciperda*, Htg., the principal cause of "wet rot" or "red rot" of timber; *Agaricus melleus*, Secr.; *Polyporus sulphureus*, Scop.; *P. vaporarius*, Krombh., and *Merulius lacrymans*, (Jacq.) Fr., causing conjointly "dry rot;" *Peziza Willkomii*, Htg., pathogenetically connected with the larch disease or "canker;" *Coleosporium senecionis*, (Fr.) Pers. (*Peridermium pini*) the cause of the "pine blister;" and *Phytophthora omnivora*, DBy., which produced the "damping off" of young seedlings. The author has endeavored in the descriptions of these diseases to put the whole matter in such language that those unacquainted with the terms of cryptogamic botany may understand, and has devoted a large portion of each chapter to the dangers from these parasites and the most reasonable methods of avoiding such.

While chapter IV, on the theories advanced to explain the ascent of water in tall trees, is perhaps too technical to harmonize well with the other chapters, it will be found one of the most interesting because it brings together in comparison for the first time in any English work, all the prominent theories, old and new, in regard to sap ascension in forest trees.

The well-known theory held by Sachs that the sap ascends through the substance of the cell walls by reason of an extraordinary activity inherent in imbibed fluid, the author is willing to abandon for Hartig's and Godlewskii's osmosis pressure theory which takes refuge in the respiration of protoplasm to furnish the lifting force. According to the views of these investigators the sap ascends by means of the tracheids of the alburnum, and is drawn or forced upwards by a periodic change which the adjacent cells of the medullary rays undergo, by reason of which they alternately absorb water from the tracheids below and expel it into those above.

The remarks upon the healing of wounds by occlusion contain many warnings against the habit altogether too common among fruit-growers and foresters, of allowing freshly broken or cut surfaces of growing trees to remain exposed to the dangers so imminent, from the hosts of parasitic fungi which only await such opportunity to gain a foothold in the tree. As might be expected, repeated references to the work of Hartig and other investigators are met with; but, throughout, the book is well worthy attention.—D. G. F.

SWINGLE, W. T. *A List of the Kansas Species of Peronosporaceæ.* Transactions of the Twentieth and Twenty-first Annual Meetings of the Kansas Academy of Science (1887–'88). Vol. XI, p. 63.

This State list, the largest one yet published we believe, containing 32 species of *Peronosporeæ*, a family acknowledged to flourish best in

moist climate with frequent showers, is remarkable as coming from a place of scanty rain-fall and long summer droughts. The author adopts for his classification that first used by Schrœter and repeated by Berlese and De Toni in Saccardo's Sylloge Fungorum, giving for convenience translations of the descriptions of family, genera, and sub-genera.

Two new species, *Peronospora hedeomæ*, K. & S., *P. cynoglossi*, Burrill, and a new variety of the latter, *P. cynoglossi*, var. *echinospermi*, Swingle, are quite fully described; measurements of 100 conidia and 25 conidiophores being given to establish the authenticity of the variety. Although it is to be regretted that there are no remarks upon the relation of this family to the atmospheric humidity it is interesting to note that the author finds only the following species as passing the winter in seeding plants: *P. arenariæ*, var. *macrospora*, *P. Arthuri*, *P. corydalis*, *P. parasitica*, *P. hedeomæ*, and *P. candida*.

The reference to an examination of every specimen for oospores as well as the carefully prepared synonomy show the work to be of the highest order. One or two changes in the authorities of some of the common species may attract attention but will be found to be well supported by the law of priority, such as *Cystopus amaranti*, (Schw.) Berk and *Peronospora parasitica*, (Pers.) Fries.

The addition of the localities from whence specimens have been obtained together with other convenient helps make the paper a very valuable one to State collectors.—D. G. F.

INDEX TO NORTH AMERICAN MYCOLOGICAL LITERATURE.

By David G. Fairchild.*

1. Dudley, W. R. Notes on investigations now in progress (with figures). Second Annual Report of Cornell Ag. Ex. Sta., 1889. Issued February 15, 1890. I. The onion mold (*Peronospora Schleideniana*, DBy.). II. Anthracnose of currants (*Glæosporium ribis*, (Lib.) Mont. and Desm.). III. Leaf-blight of quince and pear (*Entomosporium maculatum*, Lév.)

*In addition to the reviews of recent foreign articles as published in the past we propose in the future to give an index to the North American Mycological Literature, endeavoring so far as possible to bring the information down to the time each issue of the Journal goes to print. In order to facilitate the work we shall be greatly obliged if the botanists will give us notice of any articles of a mycological nature contributed by them to other than the current scientific publications; and also in giving such information to state the exact date of publication. As Experiment Station bulletins and annual reports are seldom dated exactly, it will be a great convenience if botanists will kindly state in sending their reports to us the time at which they were ready for distribution. The work will be in charge of Mr. David G. Fairchild to whom all publications and communications bearing upon the subject should be addressed.—B. T. G.

2. FARLOW, W. G. Poisonous action of *Clathrus columnatus*, Bosc. Botanical Gazette; Vol. XV, No. 2, p. 45. February, 1890. Issued March 5.

3. GALLOWAY, B. T. Fungous Diseases of Fruits and their Treatment. Colman's Rural World, March 13, 1890, an address to the Peninsula Horticultural Society, second annual meeting, Chestertown, Md.

4. HALSTED, B. D. Some Fungous Diseases of the Cranberry. Bulletin 64 of New Jersey Agricultural College Experiment Station, December 31, 1889. I. The Cranberry Gall Fungus (with figures). Discovery and history. Structure. Inspection of the bog. Related species of plants infested. Comparison of galls on differents hosts. Study of infested bog. Recommendations for combating the gall. A new and as yet undescribed species of the genus *Synchytrium* (*S. vaccinii*, Thomas) is found to be the cause of this peculiarly local and destructive disease and its structure and life history, so far as possible in one year's study, are carefully worked out. II. The Cranberry Scald (with figures). Distribution of the fungus. Description of microscopical characters. The results of the first year's investigation of this obscure and in New Jersey, at least, extremely destructive disease, in which the mycelial threads of a sphæriaceous fungus are traced from the soil of the bog up through the stem and branches to the leaves and fruit where they mature their reproductive bodies. Preliminary suggestions are given as to the possible lines of treatment.

5. Hollyhock Diseases (*Puccinia malvacearum*, Mont., and *Cercospora althæina*, Sacc). Garden and Forest. March 26, 1890, p. 158.

6. KEAN, ALEXANDER LIVINGSTON. The Lily Disease in Bermuda (with plate), Botanical Gazette; Vol. XV, No. 1, p. 8, January, 1890. Issued January 28, 1890. A carefully prepared description of the parasitism of a species of *Botrytis* identical with that described by H. Marshall Ward in Ann. Bot., November, 1888, as it appears in Bermuda upon *Lilium Harrisii*. The author suggests as a possible remedy for this threatening disease the planting of some other crop in alternate rows, which, with high and spreading foliage, will prevent the collection of dew upon the leaves, and thus check the fungus so dependent on moisture for its propagation.

7. SCRIBNER, F. L. Root-rot of the Vine (*Agaricus melleus*, Secr. and *Dematophora necatrix*, R. Hartig). Orchard and Garden, January, 1890, p. 12.

8. Black-spot of the Rose (*Actinonema rosæ*, (Lib.) Fr.). Orchard and Garden, March, 1890, p. 57.

9. SEYMOUR, A. B., and EARLE, F. S. Economic Fungi. Fascicle I. Cambridge, Mass. January 1, 1890. The first of a series of fascicles of fungi parasitic upon cultivated or noxious plants. In book form, $3.50; unbound, $3.

10. THAXTER, ROLAND. I. Smut of onions (*Urocystis cepulæ*, Frost), (with plates). Annual Report of the Connecticut Agricultural Experiment Station for 1889. Report of the Mycologist. Issued March 11. History; origin; general characters; distribution and severity; conditions influencing prevalence and increase; dissemination; retention of germinative power by spores; occurrence or non-occurrence in sets and seed onions; botanical history and relations; manner of infection; experiments for prevention; general precautions. A most admirable treatment of the disease in which the botanical history and origin as well as the practical points of inquiry are well worked out. As the fungus seems to enter the plant only beneath the ground all treatments of seedlings must be before they appear above the surface of the soil. Only powdered fungicides were applied, scattered along the drills and slightly mixed with the soil before the planting of the seed. Although the author is not warranted he believes from his tentative experiments in recommending the use of flowers of sulphur as a preventive of the disease, it appears to him at least a promising substance for that purpose; of much more value than powdered copper sulphate which prevents germination of the seed, or iron sulphate, and less expensive in cost and application than sodium sulphide. The cost with rows one foot apart when the fungicide composed of one part of flowers of sulphur mixed with an equal part of air-slaked lime is scattered evenly in the bottom of the drills and the seed planted almost directly upon it, will not exceed, exclusive of labor of application, 60 cents per acre. II. The onion mildew (*Peronospora Schleideni*, Ung.), *ibid.* III. The onion Macrosporium (*Macrosporium sarcinula*, Berk. var. *parasiticum*, Thüm.), (with figures), *ibid.* IV. The larger onion Macrosporium (*Macrosporium Porri*, Ell.), (with figures), *ibid.* V. The onion Vermicularia (*Vermicularia circinans*, Berk.), (with figures), *ibid.* VI. List of fungi parasitic upon members of the genus *Allium*, *ibid.* VII. Mildew of lima beans (*Phytophthora phaseoli*, Thaxter), (with figures), *ibid.*

11. ——— On some North American species of *Laboulbeniaceæ*. Proceedings of the American Academy of Arts and Sciences, pp. 5–14. March 15, 1890. A preliminary communication on American members of this order, to be supplemented by a more extended account; to form the second part of a proposed monograph of *Entomogenous* plants.

12. WEBBER, H. J. Uredinial Parasites. Am. Nat., Vol. XXIV, No. 277. January, 1890, pp. 75, 76.

13. ——— Peridial Cell Characters in the classification of the Uredineæ. Am. Nat., Vol. XXIV, No. 278. February, 1890, p. 177.

14. ——— Peculiar Uredineæ (with plate). Am. Nat., Vol. XXIV, No. 278. February, 1890, p. 178.

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U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF VEGETABLE PATHOLOGY.

Vol. 6. No. II.

THE JOURNAL OF MYCOLOGY:

DEVOTED ESPECIALLY TO THE STUDY OF FUNGI IN THEIR RELATION TO PLANT DISEASES.

EDITED BY

THE CHIEF AND HIS ASSISTANTS.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE.

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EDITED BY

THE CHIEF AND HIS ASSISTANTS.

CHIEF,
B. T. GALLOWAY.

ASSISTANTS,
EFFIE A. SOUTHWORTH. DAVID G. FAIRCHILD. ERWIN F. SMITH.

ANNOUNCEMENT.

By a recent act of Congress the Section of Vegetable Pathology has been made a Division, thereby placing it on an equal footing with the other branches of the Department. In view of the fact that the change in name necessitates the inauguration of a new series of bulletins, it seems a fitting time to modify somewhat the manner of issuing the JOURNAL. In the future, therefore, it is proposed to issue this publication at least four times a year, but instead of having it appear quarterly, as heretofore, we shall endeavor to publish it whenever there is sufficient material on hand to warrant us in so doing. There will be no changes made in the paging of the present volume, which will continue until four numbers, counting the one previous to this, are issued.

A NEW HOLLYHOCK DISEASE.

Plate III.

BY E. A. SOUTHWORTH.

Five or six years ago a very destructive disease made its appearance among seedling hollyhocks in a few large greenhouses in this country; it has since extended to various places in New York and New Jersey, and has nearly put an end to growing hollyhocks for bedding in the Government propagating houses in Washington.

Only a few firms grow hollyhocks in the greenhouse for bedding purposes, but these few are in most cases losing nearly their entire crop; and a reputable florist reports that the disease has quadrupled the price of hollyhocks in New York in the last two years. This malady is entirely distinct from either the well known hollyhock disease of England (*Puccinia malvacearum*, Mont.) which swept through the country a few years ago and destroyed many of the hollyhocks growing in gardens, or from the spot disease caused by *Cercospora althæina*, Sacc., described by Dr. B. D. Halsted in the Garden and Forest, March 26, 1890.

EXTERNAL CHARACTERS.

The fungus may attack any part of the plant: when on the leaf it occurs in the form of a brown spot, which may increase in size until the whole leaf is either diseased or withered; when on the petiole, the leaf and part of the petiole beyond the point of attack shrivel up at once; when at the base of the petiole, on the young unfolding leaves, or on the main stalk of the plant itself, the fungus quickly runs down to the root and kills the plant. Wherever the stem or petioles are attacked they shrivel up; all flow of sap is checked and the part of the plant or leaf beyond this point must succumb. If the plant is very dry, the diseased parts dry up, but if grown in a moist place the trouble is aggravated by swarms of bacteria that attack the diseased portions and, instead of drying up, the plant seems to perish by a kind of wet-rot. When the plant has attained some size and firmness of texture, the surface of the petiole or stem sinks in at the point of attack, forming a distinct flattening or even a hollow. The color of these spots varies from a light-yellowish brown to black. Frequently the centers of the spots are rust-color, becoming entirely black later.

BOTANICAL CHARACTERS.

The disease is due to a fungus closely resembling the well known bean rust [*Colletotrichium Lindemuthianum*, (Sacc. and Magnus) Brios. & Cava.], but the brown setæ or bristles which accompany the spores are much more plentiful than in the bean fungus. No published record of the fungus could be found and I have designated it *Colletotrichium althææ*.* In structure the fungus resemles a *Glœosporium* except for the presence of the bristles in the fruit pustules. The spores of *Colletotrichium* in general are either acicular and curved or oblong. This belongs to the latter class.

The basidia and spores are formed beneath the cuticle, which is finally rutured (fig. 5); the setæ appear after the basidia but very early in the history of the fungus. On the older spots they may become so numerous as to make the pustules appear like minute black tufts of hair, and to give the center of the spots on the stems a black color.

The spores, produced by constriction from the stalks or basidia (fig. 2), are unicellular, sometimes becoming once septate at the time of germination. They germinate quickly in nutrient solutions, and by the use of a mixture of hollyhock decoction in agar agar the fungus may be brought

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* *Colletotrichium althææ*, n. s.—Epiphyllous and caulicolous, erumpent, forming brown spots on the leaves and light-yellowish brown to black sunken spots on the petiole and stalk. Spores irregularly oblong, frequently with a light spot in the center, granular, colorless singly, flesh-colored in mass, 11–28 by 5μ. Basidia colorless, regularly cylindrical, tapering slightly or rounded at the apex, at least slightly longer than the mature spore, borne on a thin layer of pseudo-parenchyma, simple, but may branch if placed in excess of moisture (fig. 2). Setæ dark brown, abundant, once or twice septate, usually colorless below, 60–109 by 3–5μ, appear later than the basidia.

to perfection in plate cultures. In germination (fig. 4) the spores send out one or two, rarely three, germ tubes, which are continuous at first and filled with granular protoplasm. Sometimes, probably under unfavorable conditions, a secondary spore may form on the end of the germ tube after it has grown for a short distance, and by the time this spore is formed the first spore is empty. The mycelium produced in this way frequently anastomoses, and even the spores occasionally do the same thing, only one of the anastomosing spores sending out a germ tube. In the plant the mycelium is colorless, sparsely septate, and full of vacuoles. It penetrates the cavities of the cells, running through the vessels of the wood as well as the more delicate tissues. The tissues infested by it soon collapse, the cells die, and if the fibrovascular bundles are involved, as they usually are, the ascent of sap is stopped. A few cells on the edge of the spot may usually be observed which are penetrated by the mycelium, but are not collapsed.

The germ tubes developing from the spores sown in culture media may soon become closely septate, or may develop into a mycelium in which septa are only rarely visible, becoming, however, more closely septate as it grows older. The diameter is variable, the larger and older branches being as much as three or four times as broad as the smallest. The older branches are often constricted at the septa and sometimes instead of a constriction at a septum one of the adjacent segments swells up, forming a pear-shaped expansion at the end. The mycelium is colorless at first but in culture media soon grows dark colored and the contents become filled with large oily looking drops. After two or three days it is conspicuous in culture media by its dark color. Where it radiates from a single point the dark color usually extends nearly to the circumference of the spot which is bounded by a light margin composed of the still colorless hyphæ. In about seven days from the time that the spores are sown there are fully developed spore-producing pustules containing setæ on the artificially produced mycelium. Fig. 5 shows one of these very young pustules. The character of spores, basidia, and setæ is essentially the same as on the plant; the basidia may grow a little longer and the setæ are distinctly longer than any seen on the hollyhock itself (cf. figs. 1 and 3). The pustules may develop to a very large size, becoming half as large as a pin-head. They are perfectly black to the naked eye except where the spores form a flesh-colored mass on the top.

These cultures were undertaken with the hope of ascertaining whether the setæ actually belong to the spore-forming fungus. In case of the *Colletotrichium* on the bean this has been questioned because the setæ are frequently present in such small numbers that they are overlooked. This fact led to the idea that they might be parasites, or rather that there were two distinct fungi, one living upon the other.

In cultures I was never able to make one of these setæ germinate, but in one culture there were what seemed to be brown setæ, sending out long branches from their free ends. These could not be called true setæ, however, for they were shorter and broader than the typical ones,

and did not taper towards the ends, neither were they connected with fruiting pustules, but were borne directly on the vegetative mycelium. In fact, they seemed to be short, brown, aerial branches which had grown out into colorless hyphæ. In all the cultures wherever a pustule was produced the setæ were present, and although none of them were made from single spores, there is every reason to believe that they were pure cultures of the spores. No setæ could be discovered among them when carefully examined with the microscope, and they are so large as to be easily visible, moreover the setæ are not easily detached from the mycelium or pseudo parenchyma at the base of the pustule, and in some cases the spores were merely floated off from the pustule, so that the black setæ could scarcely have been carried with them. Besides, as had been said, a microscopical examination of the cultures revealed only the spores present. The material did not give positive evidence that the setæ and basidia sprang from the same hyphæ, but some of the very young pustules made this almost certain. In case of a similar fungus on cotton, I have seen the setæ bearing spores similar to those borne on the basidia, but nothing of the kind could be seen in this case.

The time of reproduction in artificial cultures agrees exactly with that in nature. Sowing the spores on the leaves of healthy hollyhocks in a drop of water produced well developed pustules in seven days.

Owing to the similarity of this fungus to *C. Lindemuthianum* an attempt was made to produce it on bean pods; this was unsuccessful, but inoculations similarly made with spores of *C. Lindemuthianum* produced the spores of that fungus. The inoculations were made by putting the spores in incisions made with a flamed knife, attempts to produce the bean fungus by sowing the spores on the outside having failed in former experiments.

No trouble was experienced in producing the hollyhock disease on healthy plants. For the first experiment three perfectly healthy seedlings, growing in a shallow pot in one of the Department greenhouses, were selected. There were sixteen plants in the dish and they were so close together that their leaves were in contact. The bases of the plants where the young leaf was not yet unfolded, and the points of union of the blade and petiole of full grown leaves were chosen as points of infection. In a week each of these three plants were diseased at one or more of the inoculated spots, while the other plants in the same dish were perfectly healthy except for a few spots of *Cercospora* on some of the leaves. These spots were entirely distinct from those caused by the *Colletotrichium* spores, and there was no possibility of confounding the two fungi. Later, two of these infected plants were killed by the fungus passing down from the young leaf to the base of the plant. This experiment was repeated by inoculating other plants in the same dish and was successful each time. The fungus which developed on these plants agreed in every particular with the one in Henderson's greenhouses.

GENERAL NOTES.

A number of circulars were sent out to prominent florists asking as to their experience with the disease. Our answers revealed the following facts: (1) Comparatively few florists have ever had any experience with the fungus, but wherever it has made its appearance it has been exceedingly destructive, the losses varying from 25 per cent. to the entire crop. (2) No one who grows hollyhocks entirely out of doors reported the disease, but some of those who reported it on seedlings raised in the greenhouse said it also attacked plants which were raised out of doors and had never been in the house. At Henderson's greenhouses it disappeared at first after the plants were bedded, but last year, owing probably to the wet season, the disease reappeared very violently after the plants were in bud and nearly ready to blossom, killing them root and all. Another correspondent reported that it attacked and killed his plants that were raised entirely out of doors. (3) Putting diseased plants out of doors may check the disease in some cases, but this is very uncertain. (4) Heat and moisture are very bad for the plants; as little as possible of each should be given.

Three dozen perfectly healthy plants growing out of doors in a cold frame were picked out from some Bay Ridge, L. I., nurseries and sent to Washington for experiments with infection. They were not carefully taken up and consequently experiments were delayed until they should recover from the set-back in growth they had received. Half of the plants were potted and put in one of the Department greenhouses while the other half were planted out of doors. Instead of recovering, and before any attempts at infection were made, the plants in the greenhouse were attacked with the fungus and were dead in two weeks. Those out of doors also became diseased, but not so badly and lingered along for some time. These plants had never been in a greenhouse; they were sowed out of doors the fall before, and had lived through the winter in a cold frame. They did not become diseased from contact with other diseased plants, for except the fungus which was produced on the seedlings already mentioned, there was none in the Department grounds, and these plants were kept in another house at some distance from the first. This would look as if the fungus could more readily attack plants whose vitality is in some way decreased, and is a hint to hollyhock growers as to the manner of transplanting.

Raising plants indoors is almost necessary if the demand for bedding plants is to be met in the spring, and consequently those who wish to raise them for the spring trade must either have some remedy for the disease or give up the business. For the purpose of ascertaining whether fungicides which have been of value in other diseases would also answer in this, the following experiment was made in Henderson's greenhouse. Three hundred plants which had been taken out of the greenhouse and put out of doors were brought in and repotted without disturbing the roots. All the diseased leaves were picked off; they were then arranged in three lots of 100 each and placed far enough apart so

that no two plants were in contact. One hundred were left untreated; 100 were sprayed every other day with the ammoniacal copper carbonate solution, and 100 with Bordeaux mixture, 4 pounds of lime to 6 of copper. Only the upper sides of the leaves were sprayed at first, but later the spray was applied to both sides. The results of the experiment were only moderately satisfactory, due in some measure at least to this early exposure of the under sides of the leaves, but in June the plants were visited and the effects of the Bordeaux mixture could be seen for some distance, the lot thus treated being much more vigorous than the other two. The effects of the copper carbonate were not very apparent. There were diseased plants among those treated with Bordeaux mixture, but the foreman of the greenhouses was so encouraged by the results that he had decided to spray the plants out of doors as well.

An experiment made at the Department by Mr. Galloway, on a smaller scale, was less successful. Plants which were dipped in the mixture developed the disease, but there is sufficient encouragement for florists to try the mixture thoroughly another year, taking especial care to spray both sides of the leaves. It is of prime importance to completely clear the greenhouses of all diseased plants and raise an entirely fresh stock. The spraying should begin as soon as the first leaves come out, and be repeated every other day.

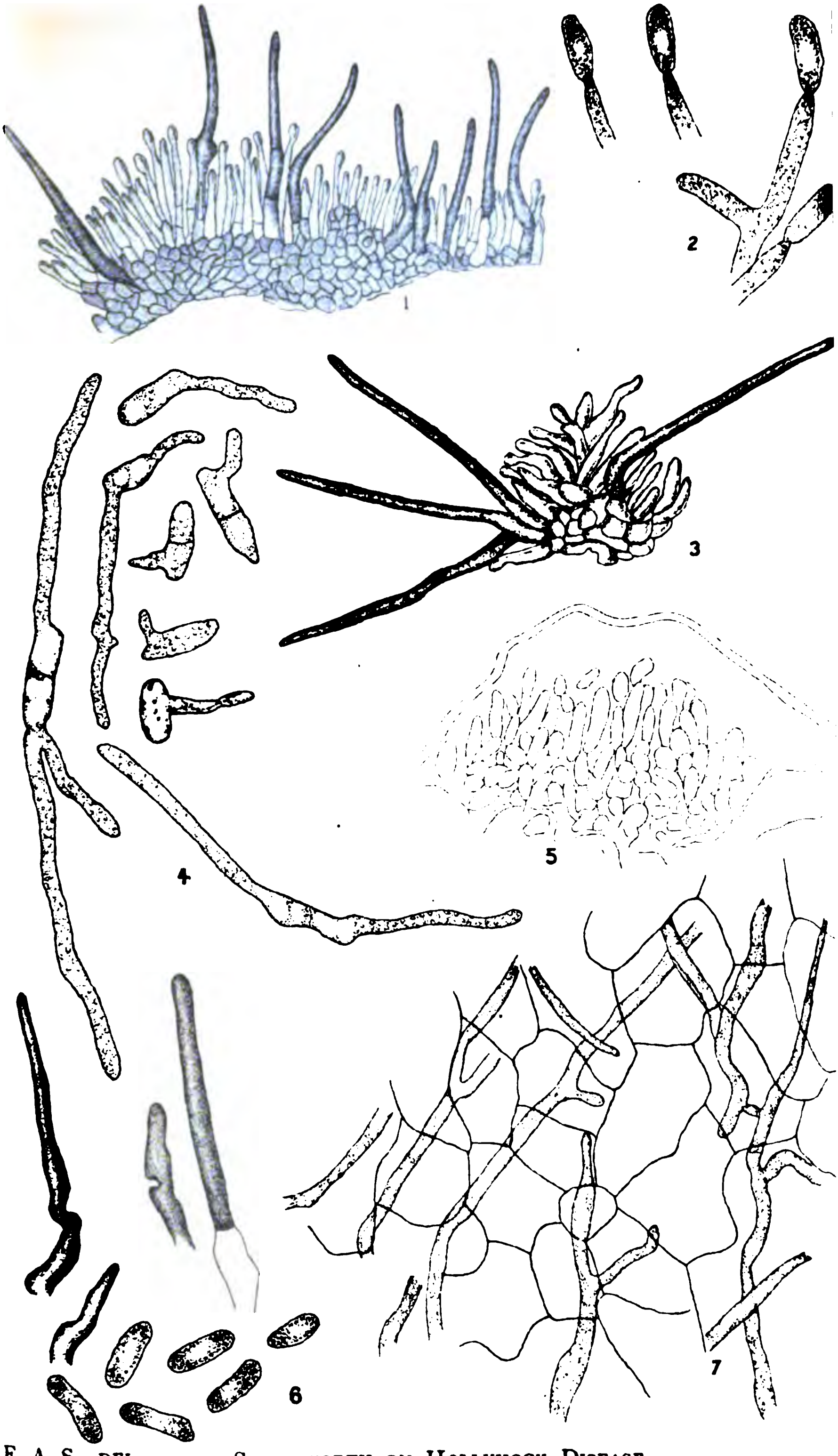
For applying the solutions on a small scale, any force-pump will answer, providing it is supplied with a suitable nozzle, such as the Vermorel or Japy. These can now be obtained from nearly all the large firms who deal in florists' supplies. Where the cultivation of the hollyhock is made an extensive business, the knapsack form of sprayer, such as described on page 51 of the present number, will be found very serviceable for applying the remedies.

EXPLANATION OF PLATE.

PLATE III.—*Colletotrichium althææ*, n. s.

FIG. 1. Section through fruiting pustule × 500.

2. Basidia bearing spores at their apices. The branched basidium was drawn from a specimen kept in a moist place × 600.
3. Small fruiting body grown on artificial substratum. It will be seen that the setæ are longer than in fig. 1, which represents the fungus on the plant. × 500.
4. Germinating spores, × 600.
5. Section through young fruiting pustule made before the epidermis had been ruptured × 600.
6. Setæ and spores × 600.
7. Mycelium in the tissue of a leaf as seen through the epidermis × 600.



E. A. S., DEL.

SOUTHWORTH ON HOLLYHOCK DISEASE.

DESCRIPTION OF A NEW KNAPSACK SPRAYER.

BY B. T. GALLOWAY.

Since writing the note in the last JOURNAL, relative to a new spraying pump designed by us, all parts of the machine have been perfected, and two firms in this city, Albinson & Company, 2026 Fourteenth street, and Leitch & Sons, 1214 D street, are now manufacturing it.

In view of the fact that any one has the privilege of making and selling this pump we have thought it best to give a detailed description of it, accompanied by illustrations of such a character that any intelligent machinist can use them as working drawings. The demand for the sprayer will be largely confined to the spring and early summer months, and to those who contemplate manufacturing it we will say that it is of the utmost importance to have the pumps in stock at this time. As a rule we find that the men who use machines of this kind wait until the last moment before sending for them, consequently they are anxious to have their orders filled promptly which, so far as our experience goes, is never done. Hence, therefore, the importance of having sufficient machines on hand to fill all orders without delay. Coming now to a description of the machine we have first:

The Reservoir (Figs. I and II).—This is made of 16-ounce copper, and

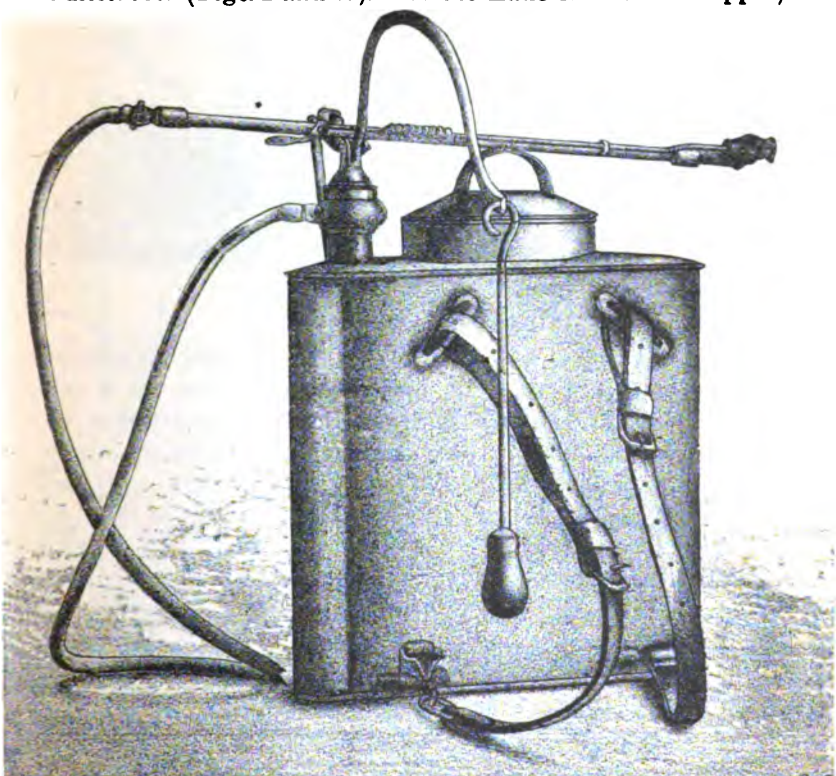


FIG. I.

holds a little over 4 gallons. We first tried 14-ounce copper, and found it too light, on the other hand 20-ounce seemed to be heavier than was necessary, so that we finally adopted the medium grade, which has given perfect satisfaction.

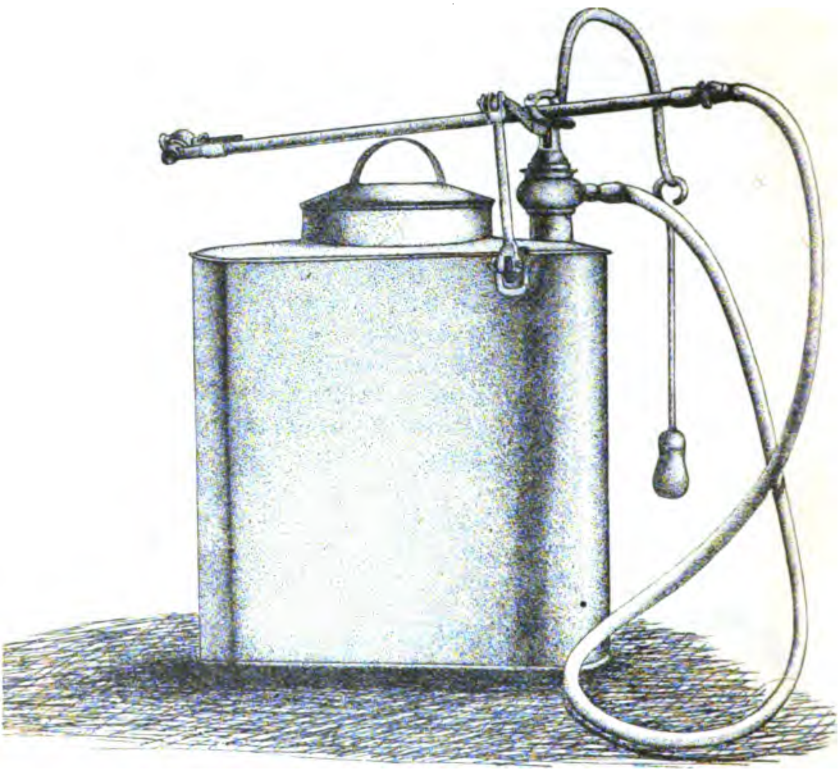


FIG. II.

The height of the reservoir is 16 inches, its breadth 15 inches, and depth 5 inches, 10 pounds of copper being necessary for a tank of these dimensions. When filled with the Bordeaux mixture, or any of the copper solutions now in use, the machine weighs practically 50 pounds, which is about as much as a man wishes to carry on his back for any length of time. In fact we find very few men able to carry such a load constantly for more than a few days at a time. This is why we did not make the reservoir larger, as some advised us to do, thinking one of 6 gallons' capacity about the proper size. Where the pumps are being used three days out of every fifteen, as is the case with many vineyardists, a 6-gallon reservoir would probably not be too heavy, but for a man using the machine six days in the week for three or four months, as must be done in large nurseries, it is simply out of the question.

The bottom of the reservoir as well as the top is soldered in, and, as is shown in Fig. III, the top is provided with two openings, one for the pump and the other for introducing the liquid. The pump orifice, *a*, is 1½ inches in diameter, while the opening for the liquid, *b*, is 4½ inches

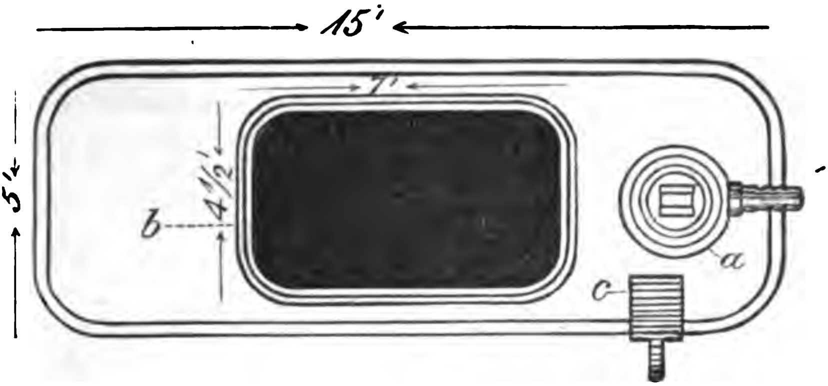


FIG. III.

wide by 7 inches long. Above and surrounding this opening is a rim 1½ inches high, into which is fitted a strainer, made of fine copper wire. The strainer, Fig. IV, rests on a slight projection made in the copper

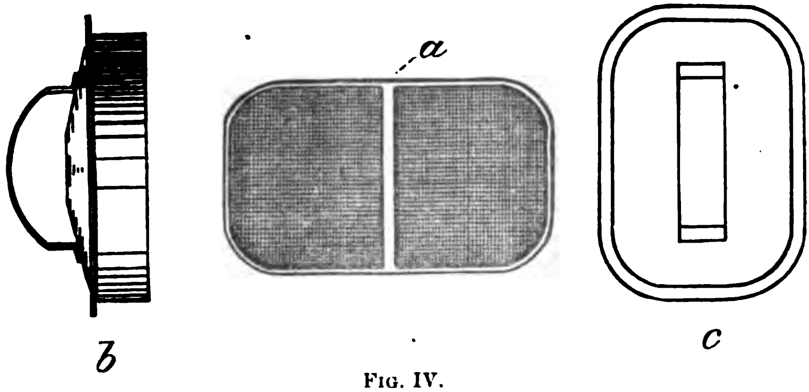


FIG. IV.

at the bottom of the rim, and is removed by means of a handle across the middle, *a*, Fig. IV. For closing the opening a lid made of copper, Fig. IV, *b* and *c*, is used, this fitting down tightly in the rim.

The Pump. (Fig. V.)—The pump is 17½ inches long and 1½ inches in diameter, and for making it 6 castings, weighing 2¼ pounds, 15½ inches of 1½-inch brass tubing and 14¾ inches of 1-inch brass tubing, are required.

It is not necessary to go into the details of the various parts of the pump, as the figures and explanations thereto will, we think, enable any one to understand the offices of the various parts. The pump is

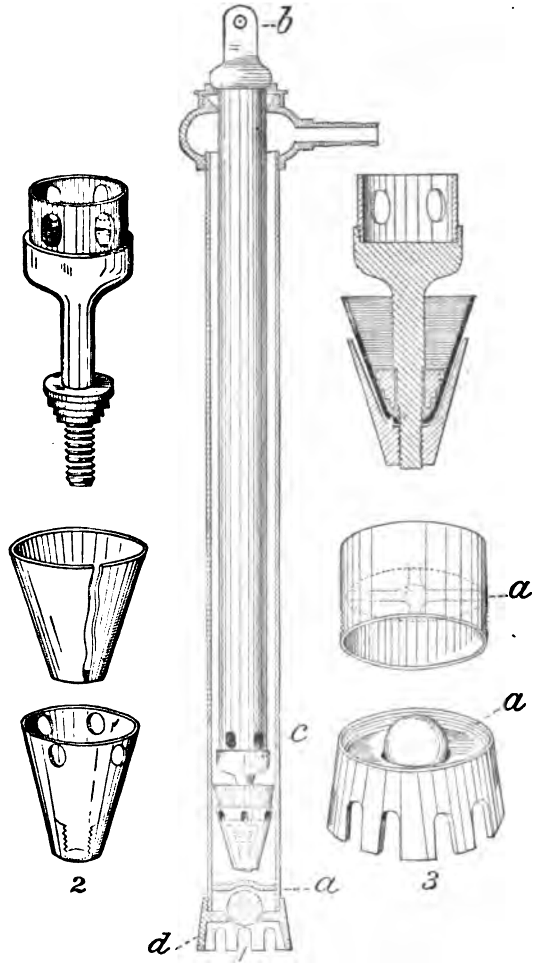


FIG. V.

soldered to the bottom of the tank, the solder being placed at the several points shown at *a* in Fig. VI.

It is fastened at the top, Fig. VI *b*, by means of solder also; for some reasons this is objectionable, but as it will not be necessary to remove the tube it is not a serious inconvenience after all. To obviate the difficulty, however, a nipple might be soldered in the tank at *b*, into which the tube could be screwed. The plunger is made in two styles, but for various reasons we have abandoned that shown in Fig. V, and now use only the form illustrated at VII. This is screwed to the end of the tube, the end being left open to do away with the necessity of side port-holes as shown at *c*, Fig. V. As seen in the cut, the plunger is not packed, the space *bb* being left for this purpose; ordinary wicking is used for packing.

In using the pump the hollow piston is drawn up creating a vacuum into which the liquid rushes through the opening *d*, Fig. V. The piston is then forced down and this closes the valve *d*, Fig. V, and opens the one at *a*, Fig. VII. This operation being repeated the liquid is forced out of the opening in a continuous stream, the latter being effected by means of the air-chamber in the piston. The figures show plainly the various parts necessary for working the pump, attaching the reservoir to the back, etc. We use as a rule about 4 feet of $\frac{7}{8}$-cloth insertion hose, and this is fastened to the pump and lance by means of copper wire.

Lance and Nozzle.—These are practically the same as described by us in a previous number of the JOURNAL,* the only difference being a change in the location of the spring which operates the degorger.

Summing up briefly the cost of such a machine as here described, we have the following:

10 pounds 16-ounce sheet-copper, at 23 cents per pound	$2.30
2½ pounds castings, at 25 cents per pound	.62
Castings and labor on lance	2.00
Straps and hose	.75
13 hours' labor, at 40 cents an hour	5.20
Total	10.87

* Vol. 5, No. II, p. 96.

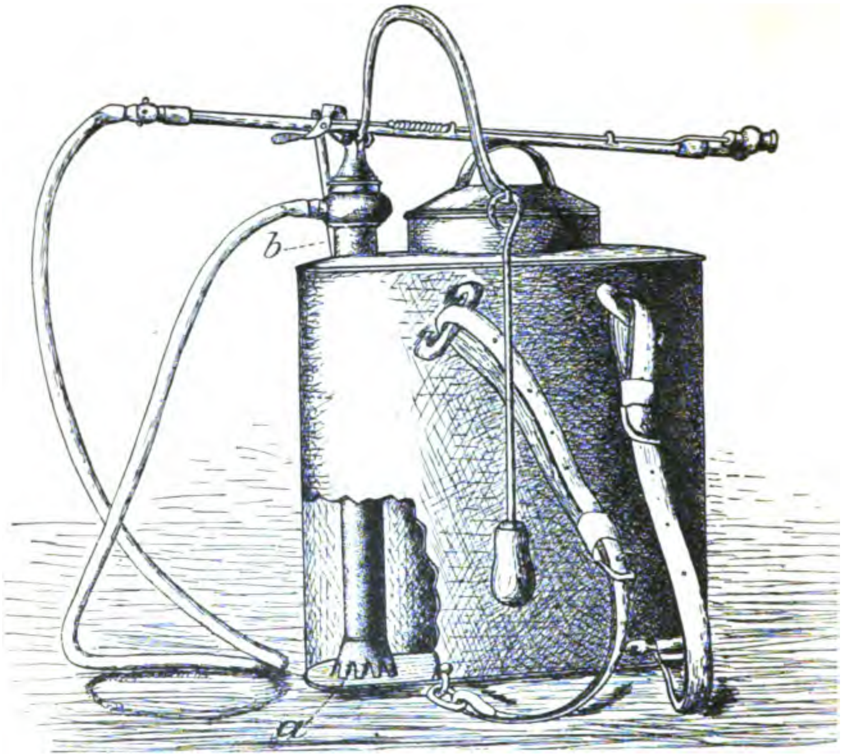


Fig. VI.

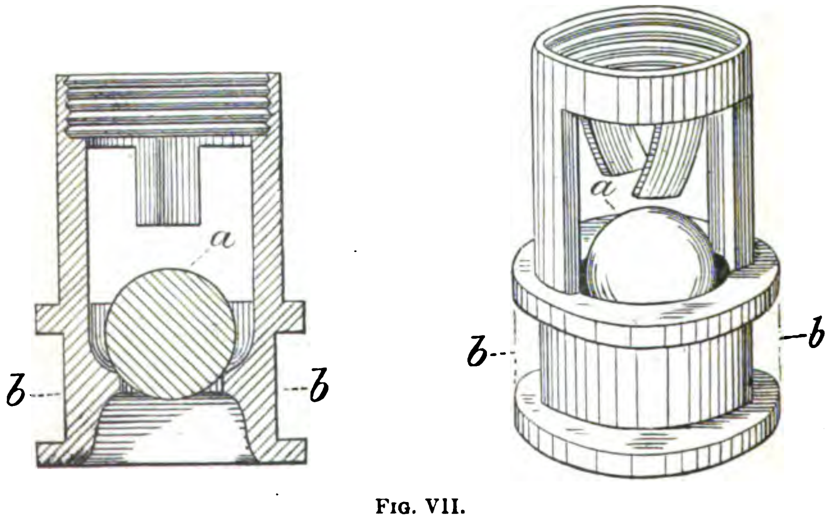


Fig. VII.

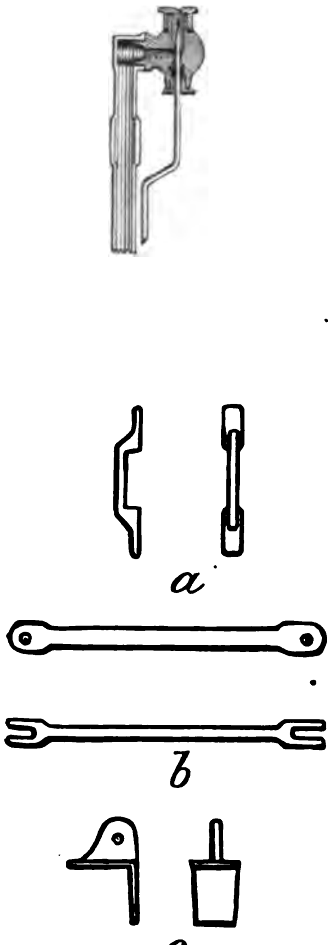


FIG. VIII.


FIG. IX.

FIG. X.

EXPLANATION OF FIGURES.

FIG. I. Front view of reservoir showing straps and attachments, pump, handle, lance, and hose.

II. Back view of reservoir showing pump, handle, lance, hose, and fulcrum; also manner of attaching the latter.

III. Top view of reservoir. Top view of pump, opening 2¼ inches in diameter *a*; opening for introduction of liquid, 7 inches long, 4½ inches wide, *b*; casting for holding the fulcrum, *c*; one-fourth actual size.

IV. Strainer, 7 inches long, 4½ inches wide, 1 inch deep; wire gauze soldered on the bottom, and handle *a* across the top; *b* and *c* lid, one-fourth actual size.

V. Pump complete. 1 one-fourth actual size; 2 and 3, one-half actual size. The plunger shown here has been abandoned and the one at Fig. VII substituted. The cross piece made of brass shown at *a* in 1 and 3 is retained in the new form. This piece holds the ball of the valve in place.

VI. Front view of reservoir showing pump inside; soldered at points seen at *a*.

VII. Plunger with ball valve showing ball at *a*, and space for packing at *bb*, actual size. The tube to which this is fastened is 14¾ inches long, making the total length with the piece marked *b*, in Fig. V, 17 inches.

VIII. Casting for attaching straps, *a*; fulcrum, *b*; casting which is soldered to reservoir *c*, as shown in Fig. II, and to which the lower end of the fulcrum is fastened by means of a bolt. All one-fourth actual size.

IX. Lance and nozzle one-fourth actual size.

X. Sprayer in use.

RECENT INVESTIGATIONS OF SMUT FUNGI AND SMUT DISEASES

AN ADDRESS DELIVERED BEFORE THE SOCIETY OF AGRICULTURISTS OF BERLIN FEBRUARY 17, 1888.

BY DR. OSKAR BREFELD,

Full Professor of Botany in Münster in W.

[Translated from *Nachrichten aus dem Klub der Landwirthe zu Berlin*, Nos. 220–222, by Erwin F. Smith.]

(*Continued.*)

As early as 1884 I began to make infection experiments on host plants, but soon, on account of the great number of details involved and the unimproved condition of my eyes, I was convinced that I could not carry through the experiments without assistance. Only upon my entrance into the Ministry of Public Instruction and transfer to Münster in Wesen was the help of an assistant in Mycology willingly granted me. This I had previously done without, having requested it of the Forest Department of the Ministry of Agriculture and been refused, although it was desired only as a compensation for my eye lost in direct government service. With this help, which I secured in the person of Dr. G. Istvanffi, privat docent in the University of Klausenburg in Hungary, I was able to bring the experiments to a relative conclusion.

But even four years ago I had carried on the culture of smut fungi in nutrient solutions for a long time, in order at least to make the first part of the investigations as complete as possible. I had cultivated the conidia of oat smut and corn smut from generation to generation for more than a year. Every four days the nutrient solutions were exhausted and the mass of yeast conidia was deposited in the culture as a distinct sediment. A few germs from the exhausted culture were always introduced by a needle-point into a new nutrient solution, and in another four days this was also exhausted. The serial cultures amounted to more than a hundred, which must have corresponded to about fifteen hundred continuous generations of the yeast conidia produced exclusively by sprouting. Yet the conidia produced in the last culture were of the same form as in the first. According to this, the sprout conidia in their unbroken succession are to be regarded as the exclusive product of the growth of these smut fungi in nutrient solutions *outside* of the host plants. This result is noteworthy in the same degree as the long-known fact that the smut spores are exclusively the form of the same smut fungi *inside* of the host plants.

Only this one change was to be observed in the continuous generations of the sprout conidia—they gradually pushed out into threads more slowly when the nutrient solution was exhausted. After ten months culture, after more than 1,000 sprout generations were formed, the germination in threads ceased entirely, the conidia swelled up somewhat and divided perhaps into two cells, but then remained passive. If we reflect that the conidia can penetrate into the host plants, to produce smut, only by means of their germ tubes, then with the disappearance of the tube germinations their infective power must also necessarily cease.

Consequently in the loss of this morphological character we have found a natural explanation for one of the much discussed special cases, viz, why the infective power of fungous germs should cease with lapse of time and with exclusive maintenance outside of the host. I will show later that as a matter of fact infections with these germs were without result, but first I will state briefly that in its composition and concentration the nutrient solution remained exactly the same during the entire period of the serial cultures; that therefore influences of nutrition and of the method of culture could not have brought about in the conidia the gradual cessation of thread germination.

The pure and satisfactory material from the sprout conidia of these smut fungi and of some others was also incidentally examined as to its possible power to induce alcoholic fermentation in nutrient solutions rich in sugar. But the forms investigated proved incapable of fermenting sugar, and could not grow at all in some of the larger masses of fluid. In these the sprouting remains nearly stationary and the germs finally die, probably from lack of sufficient access to air. From this behavior of the sprouts of the smut fungi in large masses of fluid

we can perhaps also judge of the behavior of the same germs in earth, and therefore in the soil of the field. It is scarcely to be supposed that the germs can be active in the deeper layers of the soil. It is much more probable that the condition for the vegetation of the smut fungi outside of the host plants is given only on the surface or in its vicinity, and that thence the host plants will be attacked by the smut germs.*

But, now, before I pass to the infection experiments, *i.e.*, to the production of smut diseases by infection with germs cultivated in nutrient substrata outside of the host plants, it may be judicious to state how extensive were the earlier experiments made directly and simply with the smut spores and to what results they have led.

When the smut spores dispersed in water were brought upon the surface of that part of the host in which in smutted plants the smut appears the result was purely negative; neither the penetration of the fungous germ into the plant, nor the subsequent sickening of the same, was to be observed. According to this the places where the smut shows itself in the full-grown host plants and the places where its germs penetrate into the plants could not well be the same. But neither on any other part of the full-grown plants was to be observed either the penetration of the germs or the subsequent appearance of the smut on the infected spots.

Following the earlier statements of Hoffmann it remained for J. Kühn of Halle, an eminent authority in the domain of Mycology and especially in that of smuts and smut diseases, to select young seedlings as the subjects for further experiments and observations. Kühn was the first who showed in the case of the stone smut of wheat the germ threads of the *Tilletia* in the young seedlings near the root node. Then he succeeded in doing the same thing in various forms of the genus *Ustilago*, after previous infection with the smut spores of these particular forms,—in *Ustilago maydis*, the corn smut, where three weeks after the infection he found a smut pustule in the young axis of the seedling, during the development of which the plant died; in *U. destruens*, *U. Crameri* and *U. Tulasnei*, on various kinds of millet seedlings (*Hirse keimlingen*); and also in the dusty oat smut, *U. carbo*, and in *U. bromivora* on *Bromus secalinus*. In each case he was able to establish the existence of the mycelium of the smut fungus not only in the root node and its vicinity, but also in the first stem node and sheath-leaf node and in the internode between these and the root node. Also at the same time, in these parts, he saw distinctly the points of penetration of the fungous germs.

From his numerous experiments lasting many years, by which he

* The experiments mentioned here upon the possible fermenting power of the smut yeasts, as well as the serial cultures themselves, were conducted with the most extraordinary care. The entrance of a single other yeast germ capable of causing fermentation would of course be enough to set up fermentation in the saccharine nutrient solutions and lead the experiments to wholly erroneous results.

also unquestionably showed the smut disease in the full-grown plants after previous infection of the seedlings, Kühn reached the conclusion that the regular way for a successful infection with smut fungi was through the axis of the host plant in the first stage of germination. Besides Kühn, R. Wolff also made successful infections with smut fungi in the botanical institute of De Bary in Halle. He repeated all the earlier experiments as to the places of penetration of the fungous germ into the host plants. In experiments which he made with *Ustilago carbo*, the dusty smut of oats, and *Urocystis occulta*, the stem smut of rye, he found that the germs of these fungi could not penetrate into the full-grown parts of the host plant; that only the ***sheath leaf*** of the young, just germinating host plants, is susceptible and shows clearly places of penetration. In his experiments he sprayed his young plants with smut spores dispersed in water, making use of an atomizer to secure fine droplets, which alone would adhere to the surface. The plants were then kept moist under a bell glass in order to favor the germination of the smut spores on the surface and the penetration of the fungous threads. According to the conclusion which the author draws from the sum total of his experiments, the penetration of the fungous thread takes place in the young sheath-leaf of the seedling, and here only. The germs which have penetrated grow crosswise through the young leaves of the seedling till they reach their subsequent nidus of development. This permeating growth was also observed directly in *Urocystis occulta*.

Moreover in this fungus, and only in this, was observed the appearance of the smut in full-grown rye plants which were infected in their youth. To these results reached by Wolff, viz., that the sheath leaf of the young grain plant is the only place of penetration of the smut germ into the host plants, and that the germs grow crosswise through the young seedling and penetrate to the apex of growth—Kühn soon after replied with his complete array of proof, satisfactorily maintaining and additionally fortifying his earlier view. He points out that infection through the sheath leaf, which Wolff assumes to be exclusive, is uncertain, and that while in *Urocystis occulta*, according to his numerous and many-sided experiments, smutted rye can be produced by infection of the sheath leaf, this is not possible in *Ustilago carbo* on barley, in *U. bromivora* on *Bromus secalinus*, and in forms in which the ovaries alone are smutted. He then sums up his experiences as follows: In all smut fungi which do not live in leaves, the result of infection through the sheath leaf is uncertain. Since these experiments by Kühn, which were made public in the Natural History Society in Halle in the beginning of 1874, no further accounts by other authors of infection experiments with grain smuts have appeared.

For my experiments, to the communication of which I now proceed, I chose the dusty smut, *Ustilago carbo*, on oats and barley, the millet smut, *U. cruenta* on *Sorghum saccharatum*, and finally the corn smut,

U. maydis on *Zea mays*. The first two smut forms will answer as types for smut fungi living solely in the grain, the last form as a type for smut forms which may appear not only in the grain but also in every part of the host plant, from the period of its earliest youth to complete development. All these forms belong to the genus *Ustilago*, and yield by the cultivation of their spores in nutrient solutions an endless sprouting of yeast conidia as experiment material.

The agriculturists, who listen to me, will perhaps ask themselves the question, Why not then make the experiments with the stone smut of wheat, the most important smut form upon the grains of this country? To this I will reply at once that stone smut was purposely neglected for reasons not far to seek. The stone smut of wheat, belonging to the smut genus *Tilletia*, is not a suitable object for experiment, first, because, as infective material, its conidia, cultivated in nutrient solutions and "reproduced mold-like in the air" can not be distributed so evenly and well upon the host plants, on account of their difficult dissemination and use in fluids, as can the the sprout conidia of the genus *Ustilago* which are developed under fluids; second, because in *Tilletia*, especially, the observation of the penetration of the germ into the host plant, and the further development of this within the host, is surrounded with the greatest difficulties on account of the extraordinary minuteness of the *Tilletia* germs and mycelia. Finally, it is yet to be added that in its appearance as a parasite, in the exclusive formation of the smut beds in the ovaries of the wheat, the stone smut agrees throughout with oat and millet smut, so that the results obtained in infection experiments with these plants will also unquestionably answer for the stone smut of wheat.

I will now first describe in detail the execution of the infection experiments and will add to this the results which were obtained in the different series of experiments with the isolated smut forms named.

In order to procure sufficient infective material, by the cultivation of smut spores in nutrient solutions, I proceeded in the following manner: Having the year before with the greatest care procured pure and ripe smut masses, I allowed single spores of *Ustilago carbo*, *U. cruenta*, and *U. maydis* to germinate in March or early in April in nutrient solutions on glass slides. After I was convinced, by exact observation, of the entire purity of the cultures and of the sprout conidia developed in them, I introduced a few of these conidia by means of a flamed needle into small, shallow flasks, with broad flat bottoms and short necks, constructed for the purpose, in which I had previously carefully sterilized thin layers of nutrient solutions. The sprout conidia so transferred which, in these flasks, were under the most favorable conditions for their increase by sprouting, exhausted the nutrient solutions in the flasks in three days' time and then accumulated on the bottom as a distinct precipitate. By samples taken out it was easily possible to convince one's self of the continued purity of the culture, because

the sprout conidia of the different kinds of smut fungi named always possess a definite and characteristic form, and intruding germs can be distinguished without difficulty. It was no trouble to keep unlimited quantities of these conidia, since a large number of these flasks for securing the material for infections were always prepared at the same time, in order subsequently to unite the sprout conidia out of these different flasks.

From the previously more fully described details as to the development of these fungi through the sprouting of their conidia, we now know that the multiplication ceases with the exhaustion of the nutrient solution, and that when this happens there immediately occurs a pushing out of the conidia into germ threads, which in turn, in the space of at most two days, lengthen out, but then cease to grow, and gradually perish. By means of these threads must the fungous germs penetrate into the host plants, when they begin to germinate upon their surface. Since the development into germ threads immediately stops the increase of conidia by sprouting, and since the germ threads, as they continue to develop, grow into the host plants, it follows that the sprout conidia must be transferred to the host plants, if the infection is to be attended with the best results, at a time when they are still sprouting and have not yet grown out into threads. The conidia which have already grown out into germ threads are very liable to injury by their transferrence to the host plants, and as soon as they have grown out are scarcely able to penetrate into the latter. The most favorable period for infection is very transitory in the rapidly growing conidia, and if it is missed, a normal success of the experiment is not to be expected. In view of this, the necessary precautions were taken to have the plants which were to be infected always ready in the various stages of development required for the individual experiments at the same time that the sprout conidia just described had reached their most favorable point of development for infection.

The transfer of the sprout conidia to the host or experiment plants was done with the help of an atomizer which Wolff had already used in his infections with smut fungi, and which I had myself formerly put to manifold uses in my mycological investigations. The sprout conidia from the different culture flasks were quickly united in one flask, in the neck of which the atomizer, cautiously tested for satisfactory performance, had been adjusted beforehand. Without the use of an atomizer it is impossible to bring the fungous germs upon the experimental host plants in the necessary degree of dispersion. Only in the tiniest drops do the sprayed fluids remain sticking to the parts of the plant upon which they have fallen; in case of larger droplets there occurs at once a union into drops which flow off, and consequently hinder the development on the plant and the penetration into it of the germs transferred with the droplet.

But it is now known that fungous germs are easily injured when taken in full vegetation and suddenly transferred from nutrient solu-

tions to pure water. They frequently die or, at all events, experience a weakening in their further development. In order to avoid these possible injuries to the sprout conidia of the smut fungi, I transferred the germs while still sprouting vigorously, from the culture flasks to the atomizer with the precaution to place in this first a diluted and sterilized nutrient solution. I knew to a certainty by previous experiments that in this the sprouting germs would not be injured, but rather would continue to sprout for a short time so far as the nutrient substances made this possible. In this way, it is true, a new source of error, the loss of time, is introduced, namely, the time in which the germs, sprayed upon the host plants by the atomizer, continue to sprout in the surrounding droplet before they grow out into germ tubes. However, without this error the experiment sometimes fails, because we can not spray into the host plant or administer to it the fungous germs in such ways as is customary in experiments with animals, but must apply them externally. The mixing of the fungous germs with the diluted nutrient solution in the atomizer can be regulated at pleasure according to the quantity of the germs. The mixture was always exactly tested before each experiment and not used until the trials each time had shown that at least thirty germs were present in the tiniest mist-like droplets.

The infection itself, to wit, the spraying with the fungous germs, was performed in shallow tin boxes made for the purpose. In this the nascent seedlings of the host plant were placed entirely uncovered, on soil from the field, and after the spraying, could be kept by means of a glass plate cover in a uniformly and suitably damp atmosphere at about 10° C. This was to hinder the evaporation of the sprayed droplets and at the same time to favor the development of the sprout conidia into threads and the penetration of these into the host plants. After 10 to 12 days the infected plants were set out in the open field, so as to make possible their full development and at the same time to give an opportunity for the development of smut in their spikes. But even with these very careful methods there were still serious obstacles to the success of the infection. The young seedlings exude, through stomata, especially at the apex of the shoot, drops of water which in running easily wash away the fungous germs which have been sprayed on, and in consequence may hinder their penetration and thus affect the result of the experiment. This and the already intimated sources of error in infectious, *i. e.*, in the transference of the germs directly to the seedlings, make it probable at first sight that the infection will not succeed equally well in all the plants used for experiment, but rather that it will be successful only in a portion of these. But this indefinite per cent. of accidents is still further much increased by the circumstance that in the different forms of grain-smut the receptive stage in the seedling is so very transitory that (as later results of experiments show conclusively) only those fungous germs which penetrate into the just developed seedling above the root node, and in this

way reach the apex of growth, finally come to development in the heads of the grain; all others fail.

With this, we come to the penetration of the smut germs into the host-plants, so often vainly looked for until the investigations of Kühn and Wolff threw additional light upon the subject, and till Kühn proved the penetration into the young seedlings, especially in the vicinity of the root node. Wolff later announced and represented in his drawings the penetration exclusively into the sheath leaf. Both observers in their investigations had naturally worked only with smut spores germinating imperfectly and irregularly in water.

For my observations I first began with very young seedlings. As soon as the plumule appeared (and the roots usually preceded this by a day or two) these seedlings were laid free on the earth, sprayed with the atomizer, and then examined after several days' maintenance in suitably damp air. From all parts, from the apex to the root node, pieces of the epidermis were removed carefully and their surface examined for places of penetration. These were not to be found until the third day and were to be seen with most certainty on the fourth day; later they became gradually obscure. The spots at once attracted attention by a distinct hole in the epidermis. Beneath and inward from this hole, which was often of considerable size, extended always the intruded germ tube which had already grown crosswise through the superficial cell layers and disappeared with its apex in the deeper tissues. The influence of the nutrient material inside the cells of the host plant produced a marked effect on the germ tubes. The tubes here increased visibly in thickness and in vigorous appearance, and already in the deeper optical sections showed branches, which only very seldom appeared in germinations of the conidia in exhausted nutrient solutions.

In favorable preparations portions of the surface were found which appeared as if riddled by drill-holes and were completely permeated by the numerous ingrown germ tubes to a degree not possible to be observed, even approximately, with infective material previously employed. The more recent the places of penetration, the easier it was to see the superficial conidia in direct connection, through the epidermal opening, with the germ tube which had penetrated into the surface cells. After a time this picture lost in distinctness, in proportion as all parts of the fungous germ lying on the outside became empty and transparent and only the penetrated fungous thread bore contents. Still later the hole at the place of penetration disappeared and the germ threads in the outer cells lying near the place of penetration were transformed into delicate, empty threads, still to be recognized as fungous threads, only by the deeper union with normal portions of the tubes. I am inclined to believe that these rapid changes of the penetrated fungous threads take place because of the further growth and consequent stretching of the tissue of the seedlings, which were always infected in their earliest stages, long before they were full grown, and consequently before their

individual parts had reached full size. The fungus germs can follow this stretching of the tissue of the host plant only at their extremities, not in the remoter, older parts, which are incapable of intercalary growth, and which, consequently, being subject to strain, must be obliterated by being drawn out into threads.

Even in the next series of experiments in which older plants were infected; that is, somewhat older seedlings in which the sheath leaf was over a half inch long, but not yet broken through, the places of penetration occurred more rarely, and where they were to be seen many of the penetrated germ tubes had ceased to grow in the outer cell layers. They then exhibited an entirely different appearance, viz, a strong swelling of the membranes, which was often associated with a yellowish color. These objects had an unmistakable likeness to Wolff's drawings of the penetration spots, which the author has described as forming a cellulose sheath around the penetrating germ tubes. I have never seen such a sheath in normal cases of penetration and I consider it quite probable that Wolff only saw imperfect spots of penetration, with swollen germ tubes which he mistook for cellulose sheaths, because he confined his inflections solely to the sheath leaf in which, in somewhat older stages, the penetrated germ tube can not push in any further. (Wolff, *Brand des Getreides*, Halle, 1874.)

In order to follow up these observations I made repeated infection experiments with seedlings in which the sheath leaf was nearly full grown and was already broken through for half an inch by the following leaves. Here from the root node to the uppermost point I found no longer any normal spots of penetration. Very rarely a thread was found which had pushed through the two outer cell layers, then ceased its penetration and slowly perished with swelling of its membrane. At the same time there lay upon the surface hundreds of germinated conidia which could no longer penetrate, because the epidermis, fully formed in the meantime, was no longer permeable. The seedlings, therefore, in this stage of development already behaved toward the fungous germs exactly as do all parts of fully developed plants, into which, as is well known, the threads can not penetrate and in which they can not grow further.

Up to this point of the investigation, therefore, my observations confirmed, with some additions and amplifications, the earlier results of Kühn and some statements of Wolff. Nevertheless, it would appear to me that they only partially exhaust the question as to the place of penetration of the smut germ into the host plant, and that even the new proof material which supported the old idea hitherto generally accepted, that the smut germs must penetrate into the young seedlings in order later to produce smut in the full grown plants, is still insufficient and can not well be regarded as definitely concluding the investigation. For why should the penetration occur only in the young seedling which possesses no other disposition for it except the immaturity

of its tissues, which allows the penetration of the germ? Do not all incipient tissues of the growing tip of full-grown plants likewise exhibit this immature condition?

With our ordinary cereals further experiments did not, indeed, appear to be practicable on account of their small size. The growing tips of oats, barley, wheat, etc., are too small; it is here scarcely possible to bring the fungous germ into the still closed parts of the bud; the young ovaries are also too minute to work on with sufficient clearness of view. But I will nevertheless add that the penetration of fungous germs which I had here introduced into the heart of the growing point by means of the long drawn out point of a spraying flask, was established by direct observation and the threads of the penetrated germs could be seen in the leaves.

But the long series of experiments which I conducted with the larger cereals, corn and sorghum (*Hirse*), proved this much more convincingly. Here the tip is more open. The unexpanded leaves of the bud, folded one within another, open in the form of a large cornet into which we can spray with the syringe flask unlimited quantities of the nutrient solutions containing sprout conidia. These soak down deep between the closed leaves, and in corn, can even reach the growing tip itself with its young staminate panicle, in case the latter, in a somewhat advanced stage of development, has already pushed upward far enough in the bud. Furthermore, in corn the large adventive incipient roots on the lower part of the axis, and the pistillate spikes, particularly, which appear later upon the fully developed axis as sprouts in the leaf axils, offer excellent places of attack. Of course these experiments had to be made on large plants, or, in case of the infection of pistillate spikes, on nearly full grown ones, *in the open air*, where any other protection than a temporary covering with large straw mats was no longer possible.

In order, first, to consider the experiments with sorghum and *Ustilago cruenta*, its associated smut, I will add that I have infected in the heart more than 600 plants from 1 to 3 feet high, by simple injection of the fluid containing the sprout conidia. After four days the further developed portions of the growing point, in so far as they had come into direct contact with the infective fluid, appeared somewhat yellow. Upon superficial sections, the picture of the penetration of the fungous germs was a very clear one. The whole surface was covered with holes, from which big and luxuriant tubes extended into the inner parts of the young leaves, while through their influence was brought about obviously a faint yellowing, and later a more or less distinct wrinkling and shriveling of the attacked leaves. In thin cross-sections were to be found dozens of penetration spots cut through accidentally, while the fungous tubes grew through the entire tissue of the young leaves. That in this case only the young leaves were accessible to the fungous germs was shown on the older portions of the other leaves, which, though

richly covered with germinating conidia, did not show a single penetration spot.

The experiments with corn and corn smut were carried on still more comprehensively. Infections in the heart were first made on young plants about 6 inches high and showing an open apex, up to those of more than 2 feet in height. The appearances of penetrations were uniformly observed in all parts of the young leaves and young axes, in just the same manner except that on account of the size of the corn plants they were yet more distinct than in the sorghum. All the young leaves of the bud, and the still short and unexpanded parts of the axis lying between, were susceptible to penetration, as well as the tips of the axes with the staminate panicles, when the latter were reached by the spraying of the infective fluid. The penetrations also ceased here only when all parts of the bud passed from immaturity to full development. Concerning the adventive roots, and also the side sprouts of the pistillate spikes, which appear later and were infected in the bud, I can assert exactly the same thing as for the buds of the main axis; and, finally, I will state merely for sake of completeness, that also the scattering young hairs on the leaves, which are incipient in the very young leaves, are readily attacked by the fungous germs. Penetration spots were to be seen on these with especial distinctness.

After all possible places of attack by the smut germs have been discovered, there now remains to be added the results which were obtained in the subsequent production of smut upon the proper host plants with the specified smut fungi, by means of the various sorts of infection. This is done for the purpose of arriving at such conclusions as may be drawn with scientific authority in regard to the susceptibility of the host plants used in our experiments to smut diseases at different ages and stages of development, and on the appearance and spread of such diseases.

A. I begin with *Ustilago carbo*, the notorious dusty smut which destroys the fruit of oats, barley, wheat, etc. The smut spores germinate easily and produce sprout conidia in endless generations in nutrient solutions. In mass, the sprout conidia have a hyaline appearance. Their membranes become a little slimy on the outside, so that the germs can not lie together closely, but often form loosely connected heaps, which can again be easily dispersed in fluids.

The infections by dusty smut (*Flugbrand*) were carried on with barley and oats at the same time, and altogether considerably over one hundred series of experiments were made. In order to exclude sources of error, sowings of the uninfected grains were made for comparison, concerning which I will state, in brief, that they brought forth sound culms and fruit, only showing one smutty plant in two cases.

I. For the first series of experiments the grains were chosen particularly in the earliest stage of germination, where the rootlets had already come forth and the plumule was just visible. The tiny plants were placed upon the earth uncovered and were sprinkled all over with sprout

conidia from the atomizer. The culture remained about ten days in a room at 10° C., under cover in the tin boxes previously described and then the plants were set out in the field.

In ten experiments with oats, always with a sowing of 100 grains, the result was on an average 17 to 20 per cent. of smutty panicles. The infected barley remained entirely sound.

II. In the following series of experiments the grains which barely showed rootlets were placed on the earth and so covered with a thin layer of soil, at most ½cm. thick, that only the emerging points of the seedlings were exposed and were infected by means of the atomizer, consequently the infection only reached the sheath leaf. The shoots were infected in the youngest stage when they had pushed out of the earth about ½cm.

In seven experiments with oats, each of 100 grains, the result was not more than 5 per cent. of smutty plants. The barley remained entirely sound.

III. The infection was made as in I on uncovered plants, the shoots of which were about 1½–2cm long, but did not yet show any opened sheath leaf.

Here in eight experiments with oats the result fell back to 2 per cent. of smutty plants; barley sound.

IV. Infection as in II, the sheath leaf only infected, the remaining parts of the seedlings covered with soil, but the shoot of the same length as in III.

In three experiments with oats there was 1 per cent. of smutty plants; in two experiments none were obtained; barley sound.

V. Infection of uncovered seedlings with sheath leaf already pushed through.

In two experiments with oats the result was 1 per cent. of smutty plants, in two others, none; barley sound.

VI. Experiments with infected soil in which the unsprouted grains were sown.

In five experiments with oats the result amounted 4 to 5 per cent. of smutty plants; barley sound.

VII. Experiments with an abundantly infected mixture of soil and fresh horse dung, in which the unsprouted grains were sowed.

Here in three experiments with oats the result rose to 40 to 46 per cent.; in three additional experiments, which were not conducted in a cool room, there was 27 to 30 per cent. of smut; barley again entirely sound.

VIII. Experiments with conidia, which had been cultivated ten months, generation after generation, in nutrient solutions, and which ceased to grow out into threads after the exhaustion of the solutions, infection of young seedlings lying uncovered on the earth in first stage of germination, as in I.

The result was negative. In two series of experiments there was in

one case 1 per cent., in the other 2 per cent. of smutty plants; in two additional series no smutty plants; barley sound.

IX. Experiments with larger plants by external infection and by infection in the heart of the growing tip, were wholly without result.

The final result of the experiments with oats may be summed up as follows: The infection most productive of results is upon the barely germinating young seedlings, just as it was previously stated by Kühn.

The exclusive infection of the sheath leaf is fruitful, as a rule, only in the youngest stages of the same. The infection is without result as soon as the inner leaves have pushed through the sheath leaf more than 1cm.; from this point on the plants are proof against the fungous germ. By the use of nutrient substrata for the conidia sproutings, consequently by means of earth treated to fresh horse dung, the infection of the young seedlings will be greatly increased and the spread of the smut very materially promoted,* corresponding to the experience of husbandmen in the use of fresh dung in the field. Smut germs, which have lived too long and too exclusively outside of the host plant and multiplied in the form of sprout conidia, lose their infective power conjointly with the ability to throw out germ tubes.

But how are the negative results of the experiments to be interpreted? *First*, how is it to be explained that even in the most favorable cases only a large per cent. of the experimental plants become smutty and not all which were infected? And, *second*, whence comes it that in all experiments with barley in not one single case did a plant become smutty?

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* The influence of fresh dung on the production of grain smuts diminishes quickly with the age of the dung, because the conidia germinated in it perish, and in old rotten dung the smut spores develop imperfectly or not at all. The less wet the dung the more slowly decay takes place, and the longer the smut germs can maintain themselves in it.

In the dung of horses, and of swine also, are to be found many oat and barley grains which have not been digested and which subsequently germinate in the dung. Many times by the hundred in root fields I have come across such germinated barley grains, accidentally transported into the field with the fresh swine dung, and have found that for the most part they bring forth smutty spikes. This bears most striking witness to the effect of *fresh* dung in the spreading of smut and in the appearance of smut in *freshly manured* fields. In isolated cases, in small fields, I have gathered the smutted spikes in thick bundles, and have found that out of 100 barley plants were to be found only 10 to 15 sound spikes. It need not be said that in these cases I have each time inquired very exactly and particularly concerning the way of manuring.

PRELIMINARY NOTES ON A NEW AND DESTRUCTIVE OAT DISEASE.

BY B. T. GALLOWAY AND E. A. SOUTHWORTH.

During the months of May and June we received repeated complaints and inquiries concerning a mysterious oat disease which then threatened to destroy the entire crop of the eastern and central States.

During the month of May, when the oats were from 6 inches to a foot in height, the leaves suddenly began to turn brown and die at the tips. The lower leaves were attacked first and the brown color soon extended their entire length. In a very short time all the leaves were dead, or partially brown, and the prospects were that the plants would die and the oat crop be a total failure. About the middle of June, however, the fields began to revive, the oats put out some few fresh green leaves, most of them headed out, and by the first of July many of the fields appeared in a fair condition on superficial observation. In reality, however, the losses from the disease will amount to from 35 to 75 per cent. of the crop, according to the locality. Very discouraging losses are reported from the State of Pennsylvania, where there is probably not a healthy oat field to be found. Kentucky and Tennessee have suffered even more, their present averages as reported to the Statistical Division being the lowest ever reported from any State for a staple crop.

The disease extends from New England to Georgia, and from the Atlantic coast as far west as Indiana and Illinois. It is not present in Michigan. All the agents for the Statistical Division agree in ascribing the cause of this remarkable decline in the oat crop to the same thing, namely, a "blight" or "rust" which struck the fields in May.

The disease prevented the oats from stooling well, and it frequently happened that all the shoots but the main one of a stool were killed. As a result the oats are very thin, and in riding along by a field even at a considerable distance one can see to the ground between the drill rows when the oats are in full head. Besides this the losses are augmented by the fact that the amount of green foliage which developed after the attack was not sufficient to produce a strong growth of the surviving stalks, nor to supply material for a good-sized head; the straw is therefore short and light and the heads small. The heads do not seem to be well filled, and threshing will probably reveal a lighter yield than farmers themselves expect.

Such a universal disease can be attributed to no deterioration of soil or lack of cultivation, although there is no doubt that good cultivation will produce better oats than poor, even when they are diseased. The disease has attacked oats on the best as well as on the poorest soils, fields that were fertilized as well as those that were not. The oats are best, however, in level well cultivated and well drained fields, while they are poorest in low, wet spots and on hillsides and other

places where the soil is thin. In such places they are too short to be harvested.

A very careful study of the plants has been made in the field and laboratory, but nothing in the way of a fungous or animal parasite that could cause the trouble has been found. From the nature of the disease our attention has been directed mainly to a study of it from a bacterial standpoint. Bacteria have been found in every specimen examined. Nearly 200 cultures have been made in at least a dozen different media and all have yielded two germs, one of which is exceedingly abundant. In nearly 50 cases the disease has been produced in young pot-grown plants by inoculating from direct material. Inoculations of young plants with pure cultures are now under way and it is hoped that some definite results will soon be obtained from this source.*

There is still a possibility that although the disease may be caused by bacteria they are dependent upon certain conditions of the atmosphere for their development, and need not be feared another year. Experiments to settle this question are also under way.

COPPER-SODA AND COPPER-GYPSUM AS REMEDIES FOR GRAPE MILDEW.

BY J. NESSLER.

(Translated from Biedermann's Centrall-Blatt for April, 1890, by Gerald McCarthy, N. C. Experiment Station.)

For several years preparations of copper-soda and copper-lime have been employed for mildew of the grape with good success. Neither of these preparations do any injury to the sensitive parts of the vine. The copper-soda mixture neither clogs the openings of the sprayer nor interrupts the spray by foaming; moreover, it sticks to the leaves very well. With this mixture the granular deposit is formed less rapidly the first day, but after that more rapidly than is the case with the copper-lime mixture. Sulphate of copper is decomposed equally well by soda and by lime. The granular deposit takes place sooner or later, according to the method of preparing the mixtures. Once formed, the pulverulent mass returns to its former state very quickly after being stirred, and on this account it is liable to clog the opening of the sprayer. More particularly is this the case when the lime used is not very finely divided or the copper solution is not sufficiently diluted. One should therefore use in mixing only a perfectly homogeneous lumpless lime-cream and copper solution so dilute that little or no additional water

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* Since writing this the disease has been produced in fifty or more cases by inoculating with the more abundant organism. Five days after inoculating, the characteristic discolorations appeared, and cultures made from these have yielded the typical organism in a nearly pure condition.

need be added before using. Neither mixture should be kept more than one day before being used. The lime gradually precipitates the copper in needle-shaped and granular particles, which very quickly clog the spraying-nozzle. The copper-soda solution after a short time becomes wholly unserviceable on account of the granular deposit. The more or less rapid formation of the deposit depends on the strength of the solution in soda. If, for example, one uses 4½ pounds sulphate of copper and 5¾ pounds of soda, the deposit takes place in eight or ten hours, whereas by using only 5 pounds of soda the solution remains serviceable for twenty-four hours or longer.

In using the copper-lime and copper-soda preparations one should observe the following rules:

(1) The lime must be reduced to a homogeneous lumpless cream.

(2) Both the lime-cream and soda solution must be added only to a very dilute solution of copper sulphate. Indeed this should be so dilute that no subsequent addition of water will be necessary.

(3) Although a larger amount of lime than is necessary may be added without injury to the foliage of the plants, yet according to the quantity of the lime used will be the rapidity with which the pulverulent precipitate is formed. Any surplus of soda will injure the foliage.

(4) The mixture must not be stored, but used immediately after it is prepared.

If one has water handy to the field it may be more convenient and expeditious to prepare at the house strong simple solutions of copper sulphate and soda, and dilute them afterwards in the field. One may, for example, wet 2 pounds 3 ounces copper sulphate with 1¼ gallon of water and 2 pounds 9 ounces soda with the same quantity of water, and for this purpose hot water is the best. Twenty-six ounces of burnt lime or 5½ pounds of air-slaked lime will produce 1¼ gallon of lime-cream. For the production of the final mixtures dilute 2½ gallons of the copper solution to 26 gallons and add 2½ gallons of the soda solution or the same quantity of the lime-cream. Weak mixtures act about as well as strong ones, and instead of 4½ pounds copper sulphate, one may use only 2 pounds 3 ounces. In place of 5 pounds of soda, 2 pounds 9 ounces may be used. But where the weaker mixtures are employed, it is recommended to spray somewhat more copiously.

The author has also experimented with a dry powder composed of 10 parts copper sulphate, 10 parts burnt lime, and 100 parts calcined gypsum.

Spraying with liquids is preferable to dusting with powders, because in liquid form the copper is more divided and sticks longer to the leaves; the effect being therefore more permanent. On the other hand the powder is very convenient in cases where an effective spraying apparatus is wanting and in situations where water is difficult to procure. Moreover the powder can be applied by women; the liquids can not.

NOTE ON A MINNESOTA SPECIES OF ISARIĂ AND AN ATTENDANT PACHYBASIUM.

By CONWAY MAC MILLAN.

Early in April Mr. E. P. Sheldon found on the river bank below St. Anthony's Falls, Minn., a pupa of Orgyia leucostigma, commonly known as the Tussock moth, which was covered with a growth of *Isaria*. The fungus does not correspond to any described species in all its characteristics, though I have determined it provisionally as *Isaria sphingum*, Schw., which is the conidial form of *Cordyceps sphingum*, (Tul.). The description of the Minnesota form is appended:

Stromata gregarious; 1½ to 3 centimeters high, ½ millimeter thick, and slightly subclavate, arising from a pulverulent-granulose, yellowish mycelium, conidial area but slightly thickened, hyphæ 4μ in thickness, indistinctly yellowish, conidia very minute, ovoid, 1½–2 by ½–1½μ; hyaline, deciduous.

This does not coincide exactly with the description of *Isaria sphingum*, Schw., given in Saccardo's *Sylloge Fungorum*, but in the genus *Isaria*, and throughout many of its allies exact descriptions are not attainable, owing to the failure of the older mycologists to measure hyphæ and spores as well as stromata and conidial areas.

An effort to cultivate this species of *Isaria* was made.

Portions of conidial areas were removed with sterilized forceps, and were then placed, with every precaution, in gelatine culture tubes. Some of those, prepared by Dr. George Grübler, of Leipsig, happened to be at hand and were chosen for three cultures. Repeated experiments showed that, together with adventitious forms—*Macrosporium* in one case and *Piptocephalis* in another—a very peculiar plant, clearly of the genus *Pachybasium*, Sacc.—was constantly developed in the gelatine tubes. This *Pachybasium*, distinguished by its bottle-shaped (*ampulliform*) basidia, whorled along the fertile hyphæ, as in *Verticillium*, Nees., is possibly *P. hamatum*, (Bon.) Sacc., described in the *Sylloge Fungorum* Vol. IV, pp. 149, 150. Since, however, the Saccardian description lacks measurements, a description is appended.

Forming minute yellowish patches on gelatine, becoming grayish or greenish-white, fertile hyphæ 3½–4 μ. in thickness, 40–90 μ. in length; ascending with whorls of basidia, either directly attached or with secondary branches interpolated; basidia shortly ampulliform, necks constricted, conidia ovoid 1½–2 by ½–1½ μ., clinging persistently to the basidia.

It will be seen that measurements of the spores and hyphæ of this *Pachybasium* correspond exactly with those given above for the *Isaria*, and this fact, together with the appearance of the former so uniformly in connection with the latter, might tend to give the impression that the two genera are pleomorphous and that in *Pachybasium* we have another step in the life history of *Cordyceps*. It is well known that

Isaria gives rise to peculiar forms in gelatine cultures; for example, according to Alfred Giard, reported in the JOURNAL OF MYCOLOGY, Vol. V., p. 174, *Isaria destructor* assumes the form of *Coremium*. *Coremium* is, however, a genus of *Stilbeæ* very close to *Isaria*, while *Pachybasium* is in the *Mucedineæ*. By the plate-culture methods it is hoped that absolutely pure cultures of the *Isaria* may be obtained, and if there is this genetic connection between *Pachybasium* and *Isaria* it may then become capable of demonstration. The preceding note is intended simply to direct attention to the fact that *Pachybasium* has been distinguished in American habitat, and that it may be looked for in connection with *Isaria sphingum*, Schw. on gelatine cultures of the latter form.

UNIVERSITY OF MINNESOTA.

A FEW NEW FUNGI.

BY J. B. ELLIS AND S. M. TRACY.

PHYLLACHORA STENOSTOMA, *n. s.* On leaf of *Panicum brizanthemum* from Africa. Com. Prof. S. M. Tracy. No. 501. Stromata innate, only slightly prominent, black, rather indefinitely limited, subelongated, 1–2 millimeters long, punctate from the slightly prominent hysteriiform ostiola. Ascigerous cavities small, subglobose, numerous. Asci subfasciculate, sessile, oblong cylindrical, 40–45 by 7–8μ. Sporidia biseriate, oblong, 1-septate and slightly constricted at the septum, yellow-brown, 12–15 by 3–3½μ. Bears a general resemblance to *P. graminis*, but less prominent, sporidia different besides in the narrowly compressed ostiolum which resembles a minute *Hysterium*.

FUSARIUM CELTIDIS, *n. s.* On fruit of *Celtis occidentalis*, Starkville, Miss., May, 1890, Tracy, 1333. Sporodochia scattered, erumpent, pulvinate, pale orange, ¼–1 millimeter in diameter. Basidia subfasciculately branched above, branches erect, 40–60 by 4μ, septate. Conidia fusoid, nearly straight, only the obtusely pointed ends slightly curved, 5 septate, 40–60 by 4–5μ.

CLADOSPORIUM VELUTINUM, *n. s.* On *Phalaris Canariensis*, Starkville, Miss., March, 1890. Forming velutinous, olive-brown patches ½–1 centimeter long, or by confluence longer, slightly thickening and distorting the leaf; hyphæ erect, simple, septate, subundulate, pale brown, 50–75 by 4–5μ; condia terminal, 8–20 by 4–5μ, 1–3-septate, subhyaline, the shorter ones elliptical, the longer ones oblong or cylindrical.

PUCCINIA APOCRYPTA, *n. s.* On *Asprella Hystrix*, Cañon City, Colo., Tracy, August, 1887. Hypophyllous, sori oval or oblong, occupying the entire under surface of the lower leaves and remaining covered indefinitely by the epidermis; uredospores oval, epispore thin, minutely

roughened, 20–22 by 23–26μ; teleutospores clavate or oblong, not constricted, thickened above, usually truncate with a broad flat apex but often pointed or irregular, narrowed below, smooth, 14–18 by 42–55μ; pedicel very short. Allied to *P. coronata*, Cda., but the terminal processes are either wanting or only rudimentary.

UREDO PERIDERMIOSPORA, *n. s.* On *Spartina glabra*, Ocean Springs, Miss., Tracy, September, 1889. Epiphyllous, sori linear, near the base of the leaf, long covered by the remains of the ruptured epidermis; spores bright red, pyriform, echinulate, much thickened at the apex, 19–22 by 36–45μ; pedicel short but distinct.

UREDO NYSSEÆ, *n. s.* On *Nyssa capitata*, Jackson, Miss., Tracy, November, 1888. Hypophyllous, sori minute and scattered over the entire under surface of the leaf, but not confluent; spores globose to pyriform, epispore thin, minutely echinulate, 12–15 by 15–30μ.

USTILAGO BUCHLOËS, *n. s.* On leaves of *Buchloë dactyloides*, Cooledge, New Mexico, June, 1887. Sori cylindrical, mostly about 1 centimeter long and 2 millimeters thick, covered by a thin gray membrane and filled with the black, subglobose, very minutely echinulate-roughened spores, 12–15μ in diameter. The sori occur on either side of the leaf, mostly near the tip, and resemble miniature sausages; sometimes two being found exactly opposite each other on the same leaf.

CINTRACTIA AVENÆ, *n. s.* On *Avena elatior*, Starkville, Miss., July, 1889. Transforming the ovaries into a compact black mass about as large as a small shot, made up of compact masses of subglobose spores 5–6μ in diameter, hyaline at first, brown at maturity; epispore smooth and comparatively thin.

SOROSPORIUM GRANULOSUM, *n. s.* On *Stipa viridula*, Trinidad, Colo., Tracy, June, 1887. Involving the entire flower-spike, which becomes so aborted that it barely opens the sheath of the upper leaf; spore masses globose or irregular, 50–75μ in diameter, composed of 20–50 smooth, globose, or by pressure irregular spores, 14–16μ.

USTILAGO HILARIÆ, *n. s.* On *Hilaria Jamesii*, Albuquerque, N. Mex., Tracy, June, 1887. Involving the entire flower-spike, and forming a compact cylindrical or ovate mass $\frac{1}{2}$–1 by $\frac{1}{4}$ centimeter, inclosed in a thin gray membrane; spores oval, brown, sharply echinulate, 10–14 by 12–15μ, or globose; 12–12μ. *U. cylindrica*, Pk. has smaller spores.

USTILAGO OXALIDIS, *n. s.*, N. A. F. 2424. Starkville, Miss., Tracy, May, 1888. In ovaries of *Oxalis stricta*, filling the entire ovary with a mass of reddish-brown spores; spores globose, 10–12μ; epispore rather thick, sharply echinulate.

COMBATING THE POTATO BLIGHT.

By J. H. Bünzli.

[Translated from Biedermann's Centrall-Blatt for April, 1890, by Gerald McCarthy, N. C. Experiment Station.]

The use of preparations of copper sulphate as a means of checking the potato blight has in practice proved a brilliant success. The experiments made by the author in the years 1887 and 1888 indicate clearly that potato-growers should not begrudge the small expense of applying the remedies if they aim at extensive cultivation of the potato plant. The fungicides employed in the above mentioned years were as follows:

(1) Bordeaux mixture: 17 pounds 10 ounces copper sulphate; 33 pounds lime; 34 gallons water.

(2) Copper-soda solution: (*a*), 2 pounds 3 ounces copper sulphate; 3 pounds 5 ounces soda; 26 gallons water; (*b*), 4 pounds 6 ounces copper sulphate; 6 pounds 10 ounces soda; 26 gallons water.

(3) Azurin (prepared after Morgenthaler's formula).

(4) Poudre Coignet.

For the first treatment, made before the flowers fell, the author used the preparations 1, 2*a*, 3, and 4, there being one plot for each solution. The plots were so arranged as to give to each the same exposure, fertility and texture of soil. Soon after the observation was made that wherever the azurin was used the result was unsatisfactory. The Bordeaux mixture gave quick results, but its manipulation was difficult. Under the circumstances the author concluded to use a stronger solution of No. 2*a*, and at the second spraying of the vines employed solution No. 2*b*. The Poudre Coignet was laid aside, as it was found to be of no service whatever, and besides badly burned the leaves and stems.

Plot 1 was sprayed the second time with a dilute solution of the Bordeaux mixture, viz: 6 pounds 10 ounces copper sulphate, 6 pounds 10 ounces lime, and 26 gallons of water. Plot 3 received azurin again. This second application was given at the beginning of August, but soon afterward, in spite of the Azurin, the plot was found badly affected. Part of the plot was immediately resprayed with solution No. 2*b*, but with only partial success, because the blight had already secured such an advantage that it could not be dislodged. Nevertheless the supplementary treatment showed some effect. In each treatment the author aimed to use upon one acre (*juchart*) 53 gallons to 79 gallons of fluid, put on with an efficient sprayer so that the liquids were well distributed on both sides of the leaves, insuring more complete adhesion and less risk that the material would be all washed off by the first rain.

Although the weather was copiously moist, with the inevitable result of dissolving away the protective materials used, the plots treated with the Bordeaux mixture and copper-soda solutions were still green at the

beginning of September, while on all the other plots the vines were completely dried up. Where the soda solution had been used the leaves and stems appeared large and fine; where the copper-lime mixture had been used the leaves and stems were considerably smaller.

The harvest gave the following results:

Plot 1 (Bordeaux mixtures).—Three-fourths average yield of sound tubers. The tubers were small but solid. Few were diseased.

Plot 2 (Copper-soda solutions).—Full average yield of sound tubers, besides some diseased ones. None were rotten.

Plots 3 *and* 4 (Azurin and Poudre Coignet).—One-fourth an average yield. On Plot 3, where the solution 2*b* had been used, the harvest was two-fifths of a full yield.

The author's experience leads to the conclusion that potato fields should be sprayed twice—the first spraying about July 1, the second about August 15. For early varieties the treatments should be earlier. The author especially recommends, in the order given, solution 2*b*, and the Bordeaux mixture reduced to 6 pounds 10 ounces copper sulphate, 6 pounds 10 ounces lime, and 26 gallons of water.

MUCRONOPORUS ANDERSONI, *n. s.*

BY J. B. ELLIS AND BENJAMIN M. EVERHART.

Under the bark of an oak log, Newfield, N. J., April, 1890. Found by Mr. F. W. Anderson, to whom the species is dedicated. Effused, immarginate, entirely concealed by the bark which is finally thrown off, 20 or more centimeters long and 5 centimeters broad. Pores about half a centimeter long and ⅓ millimeter in diameter, marginal ones broader and shorter, margins acute, nearly round, chestnut color, stained yellowish by the sulphur-yellow spores, (5–6 by 4–5μ), which are discharged in great abundance, coloring the inner surface of the bark and escaping through the cracks in the bark in such abundance as to cover the leaves and other things near with a bright sulphur-yellow coating. Spines not very abundant, conical at first, then elongated to 15–25μ long by 6–7μ thick.

The subiculum from which the pores arise is very thin, so that they penetrate almost to the wood. The hymenium when fresh is very soft and pliable and the walls of the pores contract in drying, so that they are often torn from their attachment below and the hymenium becomes very much cracked.

The yellow coating of spores discharged on the bark constitutes the so-called "*Chromosporium pactolinum*, Cke. & Hark." (*C. vitellinum*, S. & E. in Syll.,—*C. Isabellinum*, in N. A. F., 1391.)

INDEX TO NORTH AMERICAN MYCOLOGICAL LITERATURE.

BY DAVID G. FAIRCHILD.

15. BAILEY, L. H. **Damping off.** American Garden, Vol. XI, No. VI. June, 1890, p. 348. Thinks disease due to "potting-bed fungus," and recommends preventive remedies.
16. BENTON, L. E. **A Japanese plum disease** (with figure). Pacific Rural Press, May 17, 1890, Vol. XXXIX, No. 20, p. 505. *Taphrina pruni*, Tul., on imported species of plum.
17. BESSEY, C. E. **The diseases of farm and garden crops.** No. I. Announces series giving list of diseases to be spoken of. Nebraska Farmer, January 30, 1890, Vol. XIV, No. 5, whole No. 402, p. 89.
18. —— No. II. **Black knot** [*Plowrightia morbosa*, (Schw.) Sacc.]. *Ibid.*, February 13, 1890, Vol. XIV, No. 7, whole No. 404, p. 129. Gives popular life history with recommendation to cut and burn diseased parts.
19. —— No. III. **Stinking smut** [*Tilletia fœtens*, (B. & C.) Trel.]. *Ibid.*, February 13, 1890, Vol. XIV, No. 7, whole No. 404, p. 130. Defines "smut," gives means of propagation, and recommends blue-vitriol solution for seed-wheat.
20. —— No. IV. **Grain smut** [*Ustilago segetum*, (Bull.) Dit.]. *Ibid.*, February 20, 1890, Vol. XIV, No. 8, whole No. 405, p. 151. Recommends rotation in crops to prevent continuance of disease.
21. —— No. V. **Corn smut** [*Ustilago maydis*, (DC.) Corda]. *Ibid.*, February 27, 1890, Vol. XVI, No. 9, whole No. 406, p. 165. Notes injury from disease and danger of using manure from animals fed with smutty corn.
22. —— No. VI. **Sorghum smut** [*Ustilago sorghi*, (Link.) Pass]. *Ibid.*, Vol. XIV, No. 10, whole No. 407, p. 189, March 6, 1890. Notices appearance of smut on Mill's maize in Nebraska and Wisconsin; recommends bath of blue-vitriol water for seed.
23. —— No. VII. **The strawberry leaf-spot** (*Ramularia Tulasnei*, Sacc.). *Ibid.*, March 15, 1890, Vol. XIV, No. 11, whole No. 408, p. 209. Discusses removal of all leaves in fall, as preventive measure.
24. —— No. VIII. **Grain rust** (*Puccinia graminis*, Pers., and other species). *Ibid.*, March 27, 1890, Vol. XIV, No. 13, whole No 410, p. 250. Gives life history with well-known means of preventing spread.
25. —— No. IX. **The rust of the Indian corn** (*Puccinia sorghi*, Schw.). *Ibid.*, April 10, 1890, Vol. XIV, No. 15, whole No. 412, p. 293. Recommends all uncut fodder to be burned, thus preventing wintering of fungus.
26. —— No. X. **The raspberry stem fungus.** *Ibid.*, April 24, 1890, Vol. XIV, No. 17, whole No. 414, p. 333. Refers to destructiveness, with general means of combating the fungus.
27. —— **Seymour and Earle's economic fungi.** American Naturalist, March, 1890, Vol. XXIV, No. 279, p. 277. Remarks usefulness of the publication.
28. —— **Ellis' North American fungi.** American Naturalist, March, 1890, Vol. XXIV, No. 279, p. 277. Short comment on quality of the work.
29. BILLINGS, JOHN S. **Some tiny fungi.** Youth's Companion, Vol. 63, No. 20, May 15, 1890, p. 272. Notices bacteria, fermentation, fungus on tomato.
30. BOLLEY, H. L. **Note on the wheat rust.** Microscopical Journal, March, 1890, Vol. XI, No. 3, p. 59. Discusses question of other host than Barberry for the æcidium of *P. graminis*. Notes possible infection through sporidia or dissemination of early formed uredospores. Expresses opinion that neither *P. rubigo-vera*, (D.C.) Wint., nor *P. graminis*, Pers., are truly perennial. Suggests questions in regard to winter life and identity of *P. rubigo-vera* with European species.

31. Chester, F. D. **A botanical description of the black-rot of the grape** (with figures from Ann. Rept., Section of Vegetable Pathology, 1886). Second Annual Report of Delaware Agricultural Experiment Station, 1889, issued February, 1890. Presents in concise popular form the results of investigations of Section Vegetable Pathology, and others, into life history of *Læstadia Bidwellii*, (Ellis) V. & R.

32. —— **Peach yellows, culture tests.** *Ibid.*, pp. 92–94. Shows complete failure of attempts to produce bacterial colonies in peach-wood infusions or nutrient gelatine from portions of the inner bark of diseased twigs.

33. —— **The black-rot of the grape controlled by Bordeaux mixture.** *Ibid.*, pp. 79–87. Offers results of experiments in 1889 on vineyard of 1199 vines, near Smyrna, Del.

34. —— **Spraying with sulphide of potassium for the scab of the pear.** *Ibid.*, pp. 88–91. Reports successful experiment near Newark, Del., upon the fruit of fourteen pear trees attacked by *Fusicladium pyrinum*, Fckl. Same found in Bull. Del. Ag. Ex. Sta. VIII, March, 1890, p. 11.

35. —— **Diseases of alfalfa.** *Ibid.*, pp. 94–97. Notices *Phacidium medicaginis*. Lasch., and describes as new *Cercospora helvola*, Sacc., var. *medicaginis*, on *Medicago sativa*, with original figure.

36. Curtiss, George G. **Treatment of bitter-rot of the apple.** Bull. 11, Sect. Veg. Path., U. S. Dept. Ag., p. 38. Reports successful treatment of *Glœosporium fructigenum*, Berk., with potassium sulphide and ammoniacal copper carbonate solutions. Prefers latter solution.

37. Earle, F. S. **Experiments with fungicides for plant diseases.** Bull. 11, Sect. Veg. Path., U. S. Dept. Ag., p. 83. Notes injury to peach and plum leaves from Bordeaux mixture applied for rust (*Puccinia pruni*, Pers.).

38. Ellis, J. B., and Everhart, B. M. **Notes on a species of Coprinus from Montana** (with Plate IV). The Microscope, May, 1890, Vol. X, No. 5, p. 129. Describes and figures *Coprinus sclerotigenus*, E. & E., as new, from Great Falls, Montana.

39. Galloway, B. T. **Report on the experiments made in 1889 in the treatment of the fungous diseases of plants.** Bull. 11, Department of Agriculture, Section of Vegetable Pathology. Contains reports on diseases of grape, apple, quince, pear, plum, peach, melon, potato, tomato; with reports of Goff, Howell, Holliday, Jaeger, Scribner, Earle, and Pearson, also summary of volunteer reports on treatment of grape diseases, and announcement of new fungicides, translated from Italian of Comes & Deperais.

40. —— **Notes on the fungus of apple scab.** Bull. No. 59, Mich. Ag. Exp. Sta., April, 1890, p. 27.

41. —— **Pear leaf blight** (with fig.). Proc. 15th Ann. Meet. Am. Ass'n. of Nurserymen, 1890. Gives description of *Entomosporium maculatum*, Lév., with latest methods of treatment.

42. Goff, E. S. **Treatment of apple scab** (with Plate I). Bull. 11, Sect. Veg. Path., U. S. Dept. Ag., p. 22. Gives successful results of experiments on twelve trees with potassium sulphide, sodium hyposulphite, Bean's sulphur powder, ammoniacal copper carbonate, and Bean's liquid sulphur preparation. Decides in favor of ammoniacal copper carbonate.

43. —— **Prevention of apple scab** (with fig.). Bull. 23, Univ. of Wisc., April, 1890. Reports experiments made in connection with Sect. Veg. Path. in 1889. Reported in Bull. 11 of the Section of Vegetable Pathology, Dept. Ag.

44. —— **Prevention of apple scab, *Fusicladium dendriticum*, Fckl.** The Prairie Farmer, April 19, 1890, Vol. 62, No. 16, p. 246. Describes use of fungicides in treatment of the disease.

45. Halsted, B. D. **Why not legislate against the black knot.** Garden and Forest, April 16, 1890, Vol. III, No. 112, p. 194. *Plowrightia morbosa*, (Schw.) Sacc. is

45. HALSTED, B. D.—Continued.
noted as being from its character easily legislated against. Thinks the law should be made to include wild plum and cherry trees.

46. ——— **Anthracnose or blight of the oak.** Garden and Forest, June 18, 1890, Vol III, No. 121, p. 295. The *Glœosporium nervisequum*, (Fckl.) Sacc., attacking *Platanus occidentalis*, described in the JOURNAL OF MYCOLOGY, Vol. 5, No. II, is found causing great damage to the leaves of white-oak trees near New Brunswick, N. J. It is recommended to cut down the affected trees to check the spread of the disease.

47. ——— **Legislation against fungous diseases.** Garden and Forest, June 25, 1890, Vol. III, No. 122, p. 307. Gives copy of law of New Jersey enacted May 23, 1890, authorizing destruction of all plants which in the opinion of the officers of the State Experiment Station are so diseased as to threaten injury to agricultural interests. Owners of diseased plants to be recompensed by State. Notices, in connection, *Peronospora rubi*, Rabenh., upon cultivated raspberry, as being new to this country.

48. ——— **Nematodes and the oat crop.** Garden and Forest, July 2, 1890, Vol. III, No. 123, p. 319. Notices presence of bacteria in diseased oat plants without determination as to pathogenic nature. The presence of abundant nematodes in the small roots is thought a possible cause. Refers to articles of Comstock, Atkinson, and Neal on nematodes, and mentions possible preventive measures to be taken.

49. ——— **Anthracnose on the maple.** Garden and Forest, July 2, 1890, Vol. III, No. 123, p. 325. Mentions a tree of *Acer rubrum* standing near an oak attacked with *Glœosporium nervisequum*, (Fckl.) Sacc., as having been badly diseased with the same fungus.

50. ——— **Sweet-potato soil-rot and other forms.** Rural New Yorker, April 19, 1890, Vol. XLIX, No. 2099, p. 249. Notices "ground-rot" similar to clover sickness; soft rot due to a *Mucor;* black-rot, stem-rot, and white-rot, giving popular descriptions of the various forms.

51. ——— **Fungi injurious to crops.** Tenth Annual Report New Jersey Ag. Exp. Sta., 1889; published 1890, pp. 231–237. Notices prevalence of and remedies for potato-rot, grape-rot, cranberry gall fungus (*Synchytrium vaccini*, Thomas), cranberry scald, cucumber mildew (*Peronospora cubensis*, B. & C.), sweet-potato rots. The decay of market fruits. *Phyllosticta Halstedii*, Ell., on Lilac, (*Syringa vulgaris*, L.), mentioned as new.

52. ——— **Fungi injurious to horticulture.** Proc. N. J. State Hort. Soc., 15th Ann. Meeting, Dec. 18–19, 1889, published in 1890. Diseases of the following plants are briefly mentioned, with a possible remedy: Apple, pear, quince, peach, plum, cherry, grape, blackberry, raspberry, gooseberry, currant, strawberry, cranberry, Irish potato, sweet potato, egg-plant, tomato, watermelon, squash, cucumber, cabbage, lettuce, onion, carrot, celery, parsnip, beet, salsify, bean, pea, rose, violet, mignonette, and carnation.

53. ——— **Rusts, smuts, ergots, and rots. Some of the diseases that seriously affect field crops, vegetables, and fruits. Remedies that have proved successful.** Address before N. J State Board of Ag., Jan. 31, 1889 (May 26, 1890), Pamph. 8vo., pp. 21. Popular exposition with lists of fungi injurious to New Jersey farm crops, and illustrative plates of *Phytophthora infestans*, DBy., *Claviceps purpurea*, Tul., *Puccinia*, sp., *Tilletia* sp., and *Ustilago* sp.

54. ——— **A new white smut.** Bull. Torrey Botanical Club, April, 1890, Vol. XVII, No. 4, p. 95. Describes *Entyloma Ellisii*, n. s., as infesting the cultivated spinach, *Spinacea oleracea*. Notes *E. linariæ* forma *Veronicæ*, nov. forma, on *Veronica peregrina*, differing sufficiently from that on *Linaria vulgaris* to warrant name. Gives list of *Entylomata* with orders of host plants, showing *Spinacea* to introduce a new host order.

55. HARKNESS, H. W. **Curled leaf.** Zoë, San Francisco, Cal., Vol. I, No. 1, March 1890, pp. 87–88. Remarks on probable identity of disease of leaves of *Æsculus Californica*, with *Ascomyces deformans*, Berk.

56. —— **The nomenclature of fungi.** Zoë, San Francisco, Cal., Vol. I, No. 2, April, 1890, pp. 49–50. Remarks upon the probable identity of numerous different species described on nearly related hosts, noticing the excellent work of Dr. Farlow's Host Index, and criticising sharply the practice of species-making upon insufficient bases.

57. HARRIS, J. S. **Grape diseases.** Ann. Rep. Minn. State Hort. Soc. for 1889, Vol. XVII, pp. 284–287. Notices *Peronospora viticola*, B. & C., black-rot, white-rot, and bitter-rot; remarks on seriousness of last; gives remedies, referring to Dept. of Agr., Sect. of Veg. Path., Bull. 5.

58. HOLLADAY, A. L **Treatment of grape diseases.** Bull. 11, Sect. Veg. Path., U. S. Dep., Agr., p. 70. *Læstadia Bidwellii*, (Ellis) V. & R., and *Peronospora viticola*, B. & C., treated successfully with copper compounds.

59. HOWELL, A.M. **Report for 1889 in treating diseases of the grape and tomato** (with plates VII and VIII). Bull. 11, Sect. Veg. Path, U. S. Dept. Agr., p. 49. Describes at length course of treatment with Bordeaux mixture for *Læstadia Bidwellii*, (Ellis) V. & R.; and Bordeaux and ammoniacal copper carbonate solutions for tomato-rot (*Macrosporium* sp.).

60. JAEGER, HERMANN. **Treatment of grape diseases.** Bull. 11, Sect. Veg. Path., U. S. Dept. Agr., p. 65. Reports successful treatment of *Coniothyrium diplodiella*, (Speg.) Sacc. *Læstadia Bidwellii*, (Ellis) V. & R. and *Peronospora viticola*, B. & C. in Missouri, with note on presence of black-rot on wild species of *Vitis*.

61. JENNINGS, H. S. **Some parasitic fungi of Texas.** Bull. 9, Texas Agr. Expt. Sta., May, 1890, College Station, Texas. A list with notes on injuriousness. Several provisional new species given without descriptions. *Cercospora sp.* n. s., on *Begonia; Colletotrichium bromi*, n. s., on *Bromus unioloides; Diorchidium bouteloua* on *Bouteloua racemosa; Ravenelia Texanus*, Ell. & Galw., on *Desmanthus* or *Cassia; Tilletia rugispora*, Ell. & Galw., on *Paspalum plicatulum; Ustilago apiculata*, Ell. & Galw., on *Andropogon saccharoides*.

62. KELLERMAN, W. A. **The hackberry** (with plate). Industrialist, Manhattan, Kans., Vol. XV, No. 26, March 1, 1890, p. 109. Notices disease of hackberry "knot" caused by *Sphærotheca phytoptophila*, Kell. & Swing., and *Phytoptus*, sp., gives distribution.

63. —— **Prevention of smut.** Industrialist, Manhattan, Kans., Vol. XV, No. 25, February 22, 1890, p. 101. Reports on letter from J. L. Jensen regarding augmentation of crop by hot-water treatment, and method of using said treatment.

64. LATHAM, A. W. **Diseases of the grape-vine in Minnesota.** Ann. Rep. Hort. Soc. Minn. for 1889, Vol. XVII, p. 287. Notices "Greely rot," powdery mildew and downy mildew. Remarks latter to be the only serious disease in the section. Refers to work of Dept. of Agr. on the subject.

65. LOCKWOOD, SAMUEL. **Fungi affecting fishes. An aquarium study. First paper,** *Saprolegnia*, read March 7, 1890 (with plates 22–23). Journal New York Microscopical Society, Vol. VI, No. 3, July, 1890, pp. 67–78. Notices *Saprolegnia ferax* as attacking black sun-fish, spotted sun-fish and a species of pirate perch, in the aquarium. Twenty-four individuals succumbed to attack of fungus in six weeks. Describes and figures fungus, giving life history including formation of oospore; mentions *Dictyuchus* as found in connection with *S. ferax*. Thinks application of carbolic acid impracticable.

66. —— **Fungi affecting fishes. An aquarium study. Second paper,** *Devœa*, read March 21, 1890 (with plate 24) *Ibid.*, pp. 79–85. Gives description of *Devœa infundibilis*, n. s. attacking and destroying in an aquarium six specimens of *Hippocampus heptagonus*, Rafin., giving abundant figures of fungus, with mode of growth.

67. LONSDALE, EDWIN. **Damping off.** American Garden, Vol. XI., No. 6; June, 1890, p. 348. Mentions greenhouse methods of treatment.

68. MASSEY, W. F. **Damping off.** American Garden, Vol. XI, No. VI, June 1890, p. 347. Ventures the opinion that the disease is due to the combined action of algæ and fungi.

69. MAYNARD, S. T. **Some observations on peach-yellows** (with figures). Bull, No. 8, Mass. Hatch Expt. Sta., April, 1890, pp. 6–12. Discusses symptoms of disease; its relation to food supply, injury by cold, borers, and accident; recommends destruction of all diseased trees.

70. ——— **Damping off.** American Garden, Vol. XI, No. 6, June, 1890, p. 347. Refers diseases to a fungus and recommends course of treatment.

71. MCBRIDE, T. H. **The saprophytic fungi of eastern Iowa** (with plates IV and V), Bull. Laboratory of Nat. Hist. of State University of Iowa, Iowa City, Vol. I, Nos. 3–4, June, 1890, pp. 181–195. Continues a descriptive list, with notes on distribution and microscopical characters, begun in Vol. I, No. 1, pp. 30–44. Noticing four species of the series *Hyporhordii*, eight of *Dermini*, ten of *Pratelli*, four of *Coprinarii*, and six species of *Coprinus*. Figures in part *Agaricus campester*, *A. sapidus*, *Russula* sp. *Polyporus lacteus*, *Morchella esculenta* and *Lycoperdon cyathiforme*.

72. ——— **Common species of edible fungi.** *Ibid.*, p. 196. Describes three species, *Morchella esculenta*, Linn., *Agaricus campestris*, L., and *Lycoperdon cyathiforme*, Bosc., as fit for table use.

73. MCCLUER, G. W. **The blight of the sycamore.** Garden and Forest, July 21, 1890, Vol. III. No. 123, p. 325. Notices *Glœosporium nervisequum*, (Fckl.) Sacc., as destructive to Sycamore trees at Champaign, Ill., for twenty years; also as found in northern and western Illinois, and in fact throughout the State.

74. MEEHAN, THOMAS. **Damping off.** American Garden, Vol. XI, No. VI, June 1890, p. 347. Refers diseases to a fungus, gives possible remedies.

75. MORGAN, A. P. **North American fungi.** Journ. Cincinnati Society of Natural History, Vol. XII, No. 4, January, 1890, p. 163. Third paper. Papers 1 and 2, found in Vol. XI, p. 149, and XII, p. 22 respectively. The *Gastromycetes*, read by title, February 4, 1890, (with Plate XVI).

76. ——— **Mycological observations I.** Bot. Gaz. Vol. XV., No. 4, April 19, 1890, p. 84. Mentions habitats and peculiarities of *Schizophyllum*, *Menispora*, *Arthrosporium*, *Bactridium*, *Nœmatelia nucleata*, Schw., *Stereum albobadium*, Schw., *Dacrymyces deliquescens*, Bull.

77. PAMMEL, L. H. **Some fungous diseases of fruit-trees in Iowa.** Abstract from Proceedings of the Iowa Academy of Sciences, 1887-'89. March 10, 1890. Mentions *Entomosporium maculatum*, Lév., as defoliating all young pear-trees with the exception of Chinese variety. Notes its presence on species of *Pyrus*, *Cydonia*, *Mespilus*, and *Cotoneaster*.

78. ——— **Diseases of forage plants.** Proceedings 16th Ann. Meeting Iowa Improved Stock-Breeders Association, pp. 138–141. *Puccinia graminis*, *P. rubigo-vera*, *Ustilago maydis*, *Tilletia striæformis*, *Claviceps purpurea* are noticed.

79. ——— **Beggiatoa alba and the dying of fish in Iowa.** Proc. Iowa Acad. Sci., 1887–'89, March 10, 1890. Notices presence of the putrefactive bacterium in waters of State in connection with dead fish.

80. ——— **A cherry disease.** *Ibid.* Treats of leaf disease caused by *Cylindrosporium padi*, Karst. Discusses synonomy, and refers *Septoria cerasina*, Pk., and *S. pruni*, Ellis, to *C. padi*, Karst. Iowa specimens were found by Mr. Ellis to agree with Karsten's species.

81. ——— **Cotton-root rot.** Second Annual Report Tex. Ag. Ex. Sta., College Station, Tex., pp. 61–85 (with Plates I–V, figuring *Ozonium auricomum*, Lk., and *Verticillium*). Gives theories and general character of the disease, plants affected by the cotton fungus (*O. zonium auricomum*, Lk.); the fungus on forest and

81. PAMMEL, L. H.—Continued.
apple trees; weeds affected; botanical characters; other fungi on the roots of cotton and sweet potato; the character of the lint of diseased cotton; the seed of diseased cotton; treatment, use of fertilizers and manure; rotation of crops; how and what plants to be used in rotation; treatment of forest and apple trees; also a list of references to articles on the subject.

82. —— **New lima-bean mildew.** The Orange Judd Farmer, May 10, 1890. Gives popular description of *Phytophthora phaseoli*, Thax.

83. —— **Onion smut.** Orange Judd Farmer, April 26, 1890. Popular review of report by Roland Thaxter in Annual Report Conn. Ag. Ex. Sta., 1880. *See* 10, I.

84. —— **Smuts, wheat and oat.** Orange Judd Farmer, March 29, 1890. Popular exposition.

85. PEARSON, A. W. **Notes on strawberry culture.** Garden and Forest, March 19, 1890, Vol. III, No. 106, p. 141. Notices *Sphærella fragariæ*, Sacc., and recommends winter and spring liming. Sodium hyposulphite and potassium sulphide are thought also effective in treatment. Mentions burning with sulphuric acid as effective.

86. —— **Report of experiments made in 1889 in treatment of fungous diseases of plants.** Bull. 11, Sect. Veg. Path., p. 41. Grape maladies, apple leaf-rust, pear leaf-blight (with Plates V, VI), quince diseases, melon blight, tomato blight, potato blight, strawberry leaf-blight, are treated of and the results of field experiments with fungicides given.

87. —— **The use of fungicides in the prevention and cure of fungous diseases of plants.** Fifteenth Proceedings N. J. State Hort. Soc., Dec. 18-19, 1890, pp. 163–175. Popular address, giving results of original experiments with numerous diseases of grape, apple, pear, quince, and potato.

88. SCRIBNER, F. L. **Dotted or speckled anthracnose of the vine** (with fig.) Orchard and Garden, April, 1890, Vol. XII, No. 4, p. 82. Discusses disease, external characters, microscopical characters, quoting Viala's opinion that *Anthracnose macula* and *Anthracnose ponctuee* are caused by the same fungus. A wash of 50 per cent. solution of iron sulphate is recommended.

89. —— **Plum-rot, or the monilia of fruit** (with figs.) Orchard and Garden, May, 1890, Vol. XII, No. 5, p. 103. Notices *Monilia fructigena*, with brief life history, figuring same. Quotes Erwin F. Smith, JOURN. OF MYCOL. 5, III, and discusses treatment with copper carbonate.

90. —— **Apple scab and its treatment** (with figs.) Orchard and Garden, Vol. XII No. 6, June, 1890, p. 113. Gives distribution and destructiveness, with life history and methods of treatment, of fungus, quoting from Prof. Goff's report, Wis. Ag. Expt. Sta., 1889.

91. —— **The smut of onions** (with figs.) Orchard and Garden, Vol. XII, No. 6, June, 1890, p. 113. Reviews at length work of Roland Thaxter in Ann. Rep. Conn. Ag. Expt. Sta. for 1889, giving figures redrawn. *See* 10, I.

92. —— **Apple rust and cedar apples** (with figures taken from Ann. Rep. Sect. Veg. Path. 1888). Orchard and Garden, July, 1890, Vol. XII, No. 7, p. 134. Notices *Ræstelia pirata*, Thax., and *Gymnosporangium macropus*, Link., giving connection and life history, with recommendation to remove cedars from vicinity of orchards, plant resistant varieties of apples, and spray with the Bordeaux mixture.

93. —— **Treatment of certain fungous diseases of plants.** Special Bulletin, Tenn. Ag. Expt. Sta., May 10, 1890. Gives results of usual methods of treatment for black rot of grapes, apple scab, downy mildew of the vine, brown-rot of grapes; powdery mildew of the grape-vine, gooseberry, rose, and apple; leaf brownness of pear and quince, potato rot, smut of oats and wheat, quoting from Kans. Expt. Sta. Bull. 8, p. 95.

94. ——— **Report on the extent, severity, and treatment of black-rot in northern Ohio in 1889.** Bull. 11, Sect. Veg. Path., U. S. Dept. Ag. Notes diminished parasiticism of *Læstadia Bidwellii*, (Ellis) V. & R., and destructive nature of *Peronospora viticola*, B. & C. in this region.

95. SECTION OF VEGETABLE PATHOLOGY. **Fungoid diseases.** Ann. Rep. State Board of Hort. of California for 1889. Issued 1890. Verbatim extracts from the reports of the section for 1887-'88, treating of *Entomosporium maculatum*, Lév., *Puccinia pruni*, Pers., *Podosphæra oxyacanthæ*, D. C., *Phragmidium mucronatum*, Wint., *Actinonema rosæ*, Lib., *Sphærella fragariæ*, Sacc.

96. SEYMOUR, A. B. **A race of flowerless plants, I.** Fungi—What they are and how they live (with figures). American Garden, February, 1890, Vol. XI, No. II, p. 79. Gives general outline of saprophytic and parasitic fungi, distinguishing the two, with suggestion as to time to apply remedies; figures *Uredo* stage of *Puccinia;* section of *Hymenomycetes* and others.

97. ——— **A race of flowerless plants, II.** The metamorphoses of Fungi—How different forms change into each other (with plate). American Garden, March, 1890, Vol. XI, No. III, p. 135. Notices apple rust (*Ræstelia*) (fig.), Cedar balls (*Gymnosporangium macropus*, Link.) (fig.), wheat rust (fig.) (*Puccinia graminis*, Pers., *P. Rubigo vera* (DC.) Wint., and *P. coronata*, Corda), Black rot (fig.). Refers to system of terminology used by botanists.

98. ——— **A race of flowerless plants, III.** Yeast and Bacteria—Putrefaction and Fermentation—Pear blight, (with figures). American Garden, Vol. XI, No. IV, p. 215, April, 1890. Notices discovery of bacterial diseases in plants by Burrill, with figures of pear blight bacteria and sections of diseased and healthy pear bark.

99. ——— **A race of flowerless plants, IV.** How fungi are dispersed, with hints for the cultivator (with figures after DeBary, Pringsheim, Hine and Brefeld). American Garden, Vol. XI, No. V, May, 1890, pp. 276-278. Notices methods of spore dispersion in *Discomycetes*, *Pilobolus*, *Saprolegnia*, *Phallus*, *Puccinia*, *Claviceps*, *Ustilago*, and hints at general means of preventing spread of diseases.

100. ——— **A race of flowerless plants, V.** How fungi injure plants (with figures.) American Garden, Vol. XI, No. VI, June, 1890, p. 353. Mentions spot diseases of currant leaves; spot disease of mignonette leaves; ergot, pear scab, plum pockets, cedar apples, and corn smut.

101. ——— **Damping off** (with figures). American Garden, Vol. XI, No. VI, June, 1890, p. 349. Refers the disease to *Phytophthora omnivora*, DBy. (or *Pythium omnivora*) and *Phthium DeBaryanum*, Hesse. Thinks the latter most likely the cause of the trouble in America.

102. ——— **Notes on corn smut—a warning.** Cult. and Count. Gent., April 24, 1890, Vol. LV, No. 1943, p. 323. Describes life history of smut, and accounts for increase from year to year by reference to discoveries of Brefeld.

103. SNOW, F. H. **Experiments for the artificial dissemination of a contagious disease among chinch-bugs.** Proceedings nineteenth annual meeting Kansas State Board of Agriculture, pp. 142-144; also transactions Kansas Academy of Science, Vol. XII, Part I, for 1889 (1890), pp. 34-37. Notices *Entomophthora* disease of chinch-bug.

104. TAFT, L. R. **Experiments with remedies for the apple scab** (with plates II, III, and IV). Bull. 11, Sect. Vegt. Path., U. S. Dept. Ag., p. 30? Reports on experiment with twenty trees for disease of *Fusicladium dendriticum*, Fckl., using potassium sulphide, sodium hyposulphite, Bean's sulphur solution, ammoniacal solution of copper carbonate, modified eau celeste. Decides eau celeste and ammoniacal solution most efficient.

105. THAXTER, ROLAND. **Fungicides.** Bull. No. 102, Conn. Ag. Expt. Sta., March, 1890. Formulæ, with new spraying contrivance figured.

106. WEED, C. M. **A season's work among the enemies of the horticulturist** (with plates). Journ. Columbus Hort. Soc., Vol. IV, No. 4, December, 1889, pp. 94–106; extracted, February, 1890. Notices black rot of grape, quince leaf spot (*Morthiera mespili*, Sacc.), apple scab, brown rot of stone fruits (*Monilia fructigena*, Pers.), potato rot. Figures fruit rot and apple injured (?) by Bordeaux mixture.

107. ——— **Fungous diseases of plants and their remedies.** Bull. Ohio Agr. Expt. Sta., second series, Vol. III, No. 4, April, 1890. Notices or defines briefly potato blight or rot, apple scab (quoting from Report U. S. Dept. Ag., for 1889), pear leaf blight, powdery mildew of apple and cherry, and plum fruit rot.

108. ——— **The brown rot of the stone fruits** (with figures). The American Garden, Vol. XI, No. III, March, 1890, p. 165. Mentions attacks of *Monilia* on plums, cherries, and peaches with efforts made at Ohio Expt. Sta. to check same by use of copper compounds.

109. ——— **The potato blight.** Am. Agriculturist, July, 1890, p. 360, Vol. XLIX, No. 7. Discusses use of Bordeaux mixture and ammoniacal solution in treatment for *Phytophthora infestans*, DBy.

110. WATSON, B. M., jr. **Damping off.** American Garden, Vol. XI, No. 6, June, 1890, p. 348. Refers disease to *Pythium omnivora*, and gives preventive measures to be taken to avoid the trouble. Pricking off into fresh soil considered as the best remedy.

111. WOOLVERTON, L. **Treatment of apple scab.** Canada Horticulturist, June, 1890, p. 165. Sums up work done with *Fusicladium dendriticum*, Fckl., with special notice of JOURN. OF MYCOL., Vol. V, No. 1, p. 210.

112. ——— **The strawberry leaf blight** (with figures from Bull. XIV Cornell Univ.). Can. Hort., April, 1890, p. 109. Notices *Sphærella fragariæ*, Sacc., with review of Professor Dudley's article in Bull. XIV, Cornell Univ.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF VEGETABLE PATHOLOGY.

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EXPERIMENTS IN THE TREATMENT OF PLANT DISEASES.

By B. T. GALLOWAY and D. G. FAIRCHILD.

PART I.

TREATMENT OF BLACK ROT OF GRAPES.

The present season a series of experiments was made by the writers with a view of determining the value of certain lines of treatment for several destructive plant diseases. The results of this work we propose to set forth in two or three papers which we hope to get into the hands of fruit growers, and others directly interested, before spring. The present paper relates to an experiment made in the treatment of black rot of the grape, at Vienna, Va., 12 miles southwest of Washington.

The vineyard is the property of Capt. J. O. Berry and consists of 1,000 Concord vines sixteen years old trained to stakes 8 feet high. The vines had never been treated for rot, in fact they had been practically abandoned for the past five years on account of this disease. This, together with the fact that there had been little done in the way of pruning or soil cultivation, offered the very best means of thoroughly testing the value of the fungicides.

In the experiments an endeavor was made to throw some light on the following questions:

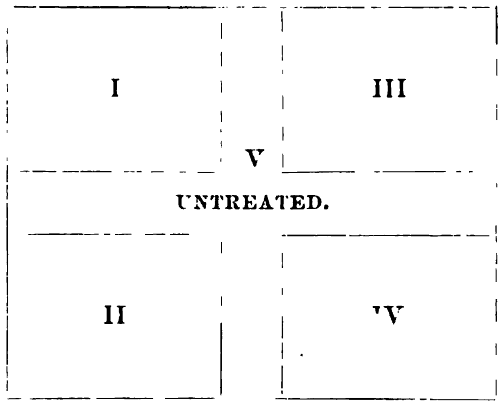
I. The best means of applying the preparations.

II. The relative value of the Bordeaux mixture, ammoniacal copper carbonate solution, copper carbonate in suspension, and a mixed treatment consisting of three applications of the Bordeaux mixture followed by five of the ammoniacal solution.

III. The actual cost of each treatment.

IV. The amount of copper found at the harvest on fruit treated with Bordeaux mixture.

The vineyard was divided into five plats as shown in the accompanying diagram.



Plat I, consisting of 203 vines, was treated with Bordeaux mixture, formula *b*.

Plat II, of 221 vines, treated with ammoniacal solution of copper carbonate.

Plat III, 167 vines, treated with copper carbonate in suspension, 3 ounces to 22 gallons of water.

Plat IV, 183 vines, treated three times with Bordeaux mixture, followed by five applications of the ammoniacal copper carbonate solution.

Plat V, 179 vines, no treatment.

All of the plats received eight sprayings, the first on May 1, and the rest, excepting the last, at intervals of fifteen days. The last spraying, on account of dry weather, was prolonged to 20 days.

Plats I to IV, inclusive, were of practically the same area, but owing to removals of dead vines an actual count revealed the number for each division to be as given above.

Of the various plats it may be said that early in the work it was observed that Plat I was made up of superior, and Plat III of inferior vines. Hence it was not expected that there would be entire uniformity in the yield of the various divisions even if the treatment for all had been the same. The pruning for 1890 was done in March, and at the same time the weeds, grass, and old berries were plowed under. This work was rather hastily done, as could be seen from the quantities of débris lying about under the vines even as late as the middle of April.

Applying the Remedies.—In this work three spraying machines were tried, namely, the Eureka, manufactured by Adam Weaber, of Vineland, N. J.; the Japy, made for us by the Columbia Brass Works, of Washington, D. C., and a Little Giant machine manufactured by the

Nixon Nozzle and Machine Company, of Dayton, Ohio. The Eureka and Japy are knapsack pumps, each holding about 4 gallons. The Little Giant is a cart machine holding 40 gallons and is designed to be drawn by hand. After a careful test of all the machines the Little Giant was selected as the one best adapted to our wants. It was provided with 16 feet of hose, and owing to the manner in which the vines were trained this enabled us to treat 4 rows at a time. There is no doubt that the knapsack pumps are less wasteful than the Nixon machine, and when arrangements can be made for properly filling them without loss of time they will doubtless be found as effectual and economical for reasonably small vineyards as any pumps now in use. Of course, for large vineyards one should have a machine capable of utilizing horse power. Throughout the experiments we used the Improved Vermorel nozzle and lance, which has already been figured and described in the published reports of this Division.*

Relative value of the treatments.—During the entire work an endeavor was made to have the conditions for all the plats as nearly alike as possible, in order that at the harvest the percentage showing the relative value of the treatments might be obtained. For reasons already given the total yields for the various plats were not to be relied upon, hence the following plan was adopted for determining the effects of the sprayings.

On July 30, when it was evident that no further changes due to the disease would occur in the fruit, the different plats were carefully examined and every bunch counted. As the counting proceeded the bunches were divided into two classes, namely, diseased and healthy. Every bunch showing five or more diseased berries was classed as diseased, while all bunches having less than five diseased berries were counted healthy. Assuming that all of the diseased bunches were *lost*, we were able by a single calculation to get the percentage of fruit saved for each plat. A comparison of these percentages shows the value of the various treatments. The only source of error in such a calculation is that some of the treated bunches might have become diseased and dropped from the vines before the count was made. This would have been serious had it not been carefully noted, at frequent intervals during the entire work, that the treated sections scarcely lost a berry.

Below are given the results of the count as above described:

PLAT I.

Treated with Bordeaux mixture.

Number of vines		203
Total number of bunches		2,289
Number of diseased bunches		19
Number of healthy bunches		2,270
Per cent. saved	99.2	

* Journal of Mycology, vol. 6, No. ii, p. 57. Circular No. 8.

Plat II.

Treated with the ammoniacal copper carbonate solution.

Number of vines		221
Total number of bunches		3,135
Number of diseased bunches		80
Number of healthy bunches		3,055
Per cent. saved	97.5	

Plat III.

Treated with copper carbonate in suspension.

Number of vines		167
Total number of bunches		708
Number of diseased bunches		45
Number of healthy bunches		663
Per cent. saved	93.64	

Plat IV.

Treated three times with the Bordeaux mixture, followed by five applications of the ammoniacal copper carbonate solution.

Number of vines		186
Total number of bunches		1,866
Number of diseased bunches		51
Number of healthy bunches		1,815
Per cent. saved	97.27	

Plat V.

No treatment.

In this plat, consisting of 179 vines, every bunch was diseased, so that according to the classification adopted the loss was total. By the 21st of July the majority of the bunches had fallen. On the 30th, however, it was thought best to count all bunches which had two or more healthy berries upon them. As a result of this count it was found that the yield was 170 bunches, none of which were fit for market.

Bringing together now the several percentages of fruit saved we have for—

Bordeaux mixture	99.20
Ammoniacal copper carbonate solution	97.50
Copper carbonate in suspension	93.64
Bordeaux mixture and ammoniacal copper carbonate solution	97.27
Untreated	00.00

Cost of the various treatments.—The total cost of treating each plat, estimating the labor at 15 cents an hour, was as follows:

Plat I.—203 *vines.*

Bordeaux mixture.

210 gallons of mixture	$4.41
14 hours labor	2.10
Total	6.51
	Cents.
Cost per vine	3.2
Cost per pound of fruit	1.2

PLAT II.—221 *vines.*

Ammoniacal copper carbonate solution.

196 gallons of solution	$1.47
12½ hours labor	1.85
Total	3.32
	Cents.
Cost per vine	1.50
Cost per pound of fruit	.77

PLAT III.—167 *vines.*

Copper carbonate in suspension.

147 gallons of solution	$0.75
10 hours labor	1.50
Total	2.25
	Cents.
Cost per vine	1.35
Cost per pound of fruit	2.08

PLAT IV.—186 *vines.*

Bordeaux mixture and ammoniacal solution.

302 gallons of mixture and solution	$3.84
10 hours labor	1.50
Total	5.34
	Cents.
Cost per vine	2.87
Cost per pound of fruit	1.64

The total yield in pounds of the various plats was approximately as follows:

	Pounds.
Plat I	540
Plat II	432
Plat III	108
Plat IV	324
Total	1,404

The fruit was sold on the vines for 6 cents per pound, making the revenue from each plat as follows:

Plat I	$32.40
Plat II	25.92
Plat III	6.48
Plat IV	19.44
Total	84.24

It will be seen by comparing these figures with those giving the total cost of the various treatments, that for Plat I, treated with Bordeaux mixture there was saved $32.40 worth of fruit at an expenditure of $6.51, leaving a profit of $25.89, or 397 per cent.

For Plat II, treated with ammoniacal copper carbonate solution, there was saved $25.92 worth of fruit at a cost of $4.32, leaving a profit of $21.60, or 500 per cent.

For Plat III, treated with copper carbonate in suspension, the value of the fruit saved was $6.48, the cost of treatment $2.25, leaving a profit of $4.23, or 188 per cent.

For Plat IV, treated with Bordeaux mixture and ammoniacal solution, the value of the fruit saved was $19.44, the expense of treatment $3.34, leaving a profit of $16.10, or 482 per cent. A further study of these figures, together with those already given, brings out a number of interesting points, chief of which may be mentioned the following:

I. That while the amount of fruit saved by the Bordeaux mixture was greater than that by the ammoniacal solution the latter preparation is, after all, the cheapest. In other words, there was more profit in using the ammoniacal solution than the Bordeaux mixture.

II. A mixed treatment consisting of Bordeaux mixture and ammoniacal solution is more profitable than a treatment of Bordeaux mixture alone, but not as profitable as the ammoniacal solution alone.

III. There is nothing whatever to be gained by treating with the copper carbonate in suspension when the ammonical solution is at hand.

COPPER ON THE FRUIT AT THE TIME OF HARVEST.

The question has often been asked whether there is any danger to be apprehended from eating grapes which have been sprayed with the Bordeaux mixture and other copper solutions.

To obtain some information in regard to this matter representative bunches were taken from Plat I, which was sprayed eight times with Bordeaux mixture.

The last spraying was made on these vines July 30, and between that date and August 28, the day of harvest, only a few slight rains had fallen. The fruit showed the mixture plainly, more pronouncedly in fact than any treated grapes seen in the market. One kilogram of the clusters ($2\frac{1}{5}$ pounds), including the stems, which appeared to have the greater part of the copper, was weighed out, dried, and analyzed.* As a result of this analysis 1 kilogram of the fruit yielded .005 grammes (.077 grain) of metallic copper. On this basis every pound of grapes treated with Bordeaux mixture contained $\frac{35}{1000}$ of a grain of copper. An adult can take from 8 to 12 grains of this salt without fear of serious results, and to get this amount from sprayed grapes he would have to eat from a ton to a ton and a half of fruit.

According to M. Fallot† the minimum amount of copper introduced into the human system daily through the food is 1 milligram, a trifle less

* The charring of the clusters was performed at the Department, but the analysis was kindly made by Dr. R. C. Kedzie, Mich. Ag. College.

† Progrés Agricole et Viticole, June 16, 1890. Bull. 11, Sect. Veg. Pathology, p. 100.

than one-half of that necessarily taken with each pound of grapes, stems and all, sprayed as profusely as those analyzed.

When it is considered that 203 vines received in one season's treatment only 57.25 pounds of copper, or 4½ ounces per vine, the very inconsiderable amount which remains adherent to the berries is not to be wondered at. Although spraying after the middle of July with the Bordeaux mixture is to be avoided, it will be seen that there is no real danger arising therefrom, and when the ammoniacal solution is substituted for the last three sprayings, since it contains only $\frac{1}{32}$ as much copper, there can be no possible danger.

DISEASES OF THE GRAPE IN WESTERN NEW YORK.

Numerous complaints having been received from correspondents in various parts of western New York of a disease which was seriously injuring grape vines, it was decided to send some one into the field to investigate the matter. Accordingly, on October 18, Mr. D. G. Fairchild was directed to visit Lockport, N. Y., and such other points within the State as might be necessary, and to obtain such information and make such investigations as would enable him, if possible, to determine the cause of the trouble and suggest a remedy therefor. Below is Mr. Fairchild's report.

B. T. GALLOWAY,
Chief of Division.

WASHINGTON, D. C., *October* 25, 1890.

SIR: In accordance with your instructions, I left Washington on October 18, proceeding directly to Lockport, N. Y., where, through the kindness of the Niagara White Grape Company, I was enabled to obtain much valuable information relative to the new disease of the grape, which is generally referred to under the name of "blight" or "rust." After leaving Lockport several important grape-growing regions were visited, in all of which the new trouble was found more or less abundantly. I submit my report on the investigations made, and also add some notes on other vine diseases which came under my observation.

Respectfully,

D. G. FAIRCHILD,
Assistant.

The attacks of the disease seem to be confined to bearing vines three or more years from planting. So far as known, it has occurred, during the past season, only in the grape-growing districts of western New York, and is now present in Niagara, Wayne, Cayuga, Seneca, Steuben, and Ontario Counties. While it may be presumed that the same trouble exists in the intervening counties, and, perhaps, in other sections along the Great Lakes, it has not been definitely reported from these localities. This year the disease appeared simultaneously in the different districts soon after September 1, and in most of them for the first time, but in one locality, Ontario, Wayne County, it is reported to have appeared for the first time two years ago, when it did considerable damage. One vineyard was observed which was previously affected, and in this the area diseased this year did not appear to be entirely coincident with the portion worst affected two years ago.

CHARACTERS OF THE DISEASE.

Small irregular blotches of a dark color appear between the veins, these enlarge rapidly, darken to a dull purplish or reddish brown and coalesce so as to fill up the space between the veins which remain green or yellow. These changes occur so rapidly that the foliage seems to change color suddenly. The contrast between the green or light yellow veins and dark purplish brown of the intervening tissues gives a peculiar streaked appearance to the leaves. In the most serious cases they curl up, become dry and brittle, and finally drop from the vine, leaving it nearly bare.

The berries borne upon diseased vines, almost without exception, have a flat, insipid, and often intensely sour taste, due to the fact that they are only partially ripened. When the attack is severe the berries drop off, and the ground beneath a diseased vine is often seen to be covered with half ripe grapes. The berry is found to part from its pedicel taking with it the fibers which enter the interior of the pulp and are normally withdrawn from it when the berry is pulled off. After the crop has been harvested, also, the bunches are found to "shell" badly, ruining them for market.

The roots of diseased vines, when carefully examined, fail to show a healthy growth of young feeding rootlets. When the roots of healthy and unhealthy vines are compared, although as is to be expected late in the season (October 20–25) the fibrils have many of them dropped from all vines, the difference in favor of the healthy vines points quite plainly to the fact that root absorption has been stopped earlier where the disease is present. This early stoppage of the action of the rootlets may account for the peculiar coloring of the leaves and failure of the canes to mature their wood.

As will be seen from the following somewhat free translation from Pierre Viala's work (The Diseases of the Vine, p. 432) the malady corresponds in many respects to what this eminent viticulturist calls *Rougeot* and which he considers a mild form of the destructive *Apoplexie* which has been long noticed in France.

Grape leaves sometimes suddenly assume a red color, especially in midsummer at the heated periods when there are strong dry winds or when the temperature falls suddenly. The leaf tissues become leathery and fragile between the veins, and the color, which normally would be that of a dead autumn leaf, is a bright, almost rose red and at times a wine color, while the veins remain green or yellowish, later the color becomes dull and the leaves dry up.

The yellowish shoots dry up, beginning at their bases. But the vine is not diseased beyond recovery as is the case with Folletage. It puts out green branches in the course of the same year and in the following year the only evidence of the disease is a slight weakness of the vine.

G. Foëx, in his Complete Course of Viticulture,* thus describes under the same name a disease which he considers somewhat distinct from *Apoplexie* or *Folletage:*

Rougeot is a disease which resembles Folletage in the conditions which cause it as well as in its general effects. Like this, it attacks the vine while it is in full growth, at the first heated period, and prevails especially in deep and cold soils.

Thiebaut de Berneaud† says that it is produced during the summer after a cold rain, a storm which suddenly lowers the temperature, or even a fog, when these are succeeded by warm south winds.

M. Mares‡ gives the following description:

"The leaves change, becoming like parchment, and lose their flexibility; the tissue between the nerves becomes red, while the nerves themselves remain green, giving the leaves of diseased vines quite a peculiar appearance; the berries shrivel, the canes remain yellow, and if the malady becomes more severe the leaves dry up entirely and the canes partially die—rotting from the extremity to the base. A vine is sometimes attacked only upon one side, which becomes brown, while the other parts remain green. * * * The vines diseased with rougeot do not die, as in the case of apoplexie, but are much injured, and their natural fertility is considerably diminished, only recovering after several years. Drainage appears to be, as in the case of apoplexie, the best means of diminishing the chances for the development of this malady."

While the above descriptions contain many conflicting statements it is reasonably certain that the malady seen by the various authors is the same and is probably of a like nature to the one in question. Viala in his *Mission Viticole en Amerique* mentions folletage, of which he considers rougeot a mild attack, as occurring in the Atlantic States, especially in the South.

A careful microscopic examination of all parts of the diseased vine has revealed absolutely nothing of the nature of a parasitic fungus which could in any way be connected with the malady. Leaves, canes,

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*Cours complet de Viticulture, par G. Foëx, Paris, 1888, p. 421.

†Nouv. Manuel complet du Vigneron français. Manuels Roret, p. 186, quoted by Foëx.

‡Des Vignes dans le Midi de la France in le Livre de la Ferme, Paris, Masson, 1865, p. 173, quoted by Foëx.

and roots seem perfectly free from any form of parasitic plant or animal. However, as this examination was only made late in the season, the decision as to the presence of parasitic organisms can not be considered as final.

CAUSES.

On the other hand, circumstances in this case as with the disease in France point to a close relation between the diseased vines and the condition of the soil with regard to drainage. In general it may be said that the worst attacks of the disease occur upon cold, heavy soils containing a large percentage of clay and rich in nitrogenous matters. Of the nine vineyards visited, which were over three years old from planting, seven showed the disease badly, and of these five were not underdrained and the remaining two only partially so. In the two vineyards which were upon high, well drained land the trouble was present only in its mildest form, in fact the attack was so slight that the owners had not noticed it. In one vineyard two adjacent plots, one cultivated for years as the family garden, the other in the regular farm rotation, showed a most striking contrast. The garden plot, although situated nearer the base of the slope, showed no signs of the trouble, while the plot in regular rotation had most of its vines badly diseased. Notwithstanding these facts, however, in particular vineyards the appearance of diseased vines upon its most elevated portions showed the disease was not wholly confined to cold, deep soils.

So far as the investigation goes there seems to be no connection whatever between the fertilizers used and the trouble, diseased plants being found upon land unmanured, heavily manured, fertilized with phosphates, wood ashes, and bone dust. In all cases the soil, although not chemically examined, seemed to be rich in nitrogenous matters and was fertile in every sense. It seemed, however, to lack one element, lime, which had not been applied and was evidently not abundant.

SUGGESTIONS IN REGARD TO TREATMENT.

In cases where the soil is at all inclined to retain more moisture than necessary, thorough underdraining will probably be the surest means of preventing a second attack. Should the vines show no mature wood available for the next year the better plan will be to prune close to the ground and raise an entirely new growth. Where the attack has been slight and enough mature wood remains to grow new bearing canes another season, such severe treatment is not necessary.

In any case, the pruning should be postponed as late as possible in order to give the canes that are still green all possible opportunity to ripen. The diseased vines should not be allowed to bear heavily the coming season, as the necessary strain may favor a second attack of the disease. Further investigations are, of course, necessary to ascertain more definitely the immediate cause of all such maladies.

BLACK ROT.

The presence of this disease was noted in all the counties visited, but its attacks this season have evidently been slight as compared with its ravages farther south, only an occasional cluster being attacked. That the malady has gained a foothold throughout this section can not be doubted, but timely applications of the copper mixtures will, if early undertaken, prevent severe ravages in future seasons.

ANTHRACNOSE.

Found sparingly at Fair Haven, Lyons, and Romulus, where it had damaged the fruit principally, only an occasional cane being affected.

DOWNY MILDEW.

This disease appears to be one of the worst pests of the New York vineyardist, presenting itself in the form of gray rot or brown rot in most of the vineyards visited, but as far as seen doing only slight damage to the foliage.

POWDERY MILDEW.

Numerous cases of this fungus were seen in almost every vineyard examined, except those sprayed with some of the copper mixtures. The fruit where attacked becomes discolored, and accumulations of dust which can not be removed occur upon the diseased portions rendering the clusters unfit for market.

GRAPE GLŒOSPORIUM.

This disease,* to be described in another number, although a new one, should be carefully looked after. It was noted in every packing house visited, and although any of the copper remedies would doubtless check its ravages it is likely to prove a troublesome pest.

GRAPE CLADOSPORIUM.

Upon two vines of Clinton in Cayuga County the immature stage of a species of *Cladosporium* was noticed in connection with powdery mildew. The berries attacked assumed a dirty orange-yellow hue, became rough and unsightly, and were ruined for market purposes. It is hoped that the mature spores of this fungus may be found and the species identified, but as yet only the mycelial form has been seen forming a thick felt composed of much torulosed mycelium upon the epidermis of the berry.

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*Ann. Report, 1890.

ANTHRACNOSE OF COTTON.*

(Plate IV.)

By E. A. Southworth.

This disease, like others of the same name, is exceedingly destructive to the plants which it attacks and is caused by a fungus resembling the Glœosporiums. The presence of dark colored setæ among the spores and basidia separates it from the genus *Glœosporium* and makes it a *Colletotrichium*, but the general character of the fungus, so far as its effect on the host is concerned, is very similar to that of the Glœosporiums, well known as Anthracnose of the grape and raspberry. In the cotton fungus the setæ do not at first develop in any numbers, but become very numerous as the fungus grows older.

When the fungus was first brought to our notice, some immature specimens were sent to Mr. Ellis, who afterwards sent them to Mr. Cooke; both agreed that they were identical with *Glœosporium carpigenum*, Ck. & Hk., and the fungus was distributed in Ellis's North American Fungi under this name. Through the kindness of Professor Harkness I have recently been enabled to compare it with type specimens of *G. carpigenum*, and find it quite distinct from this fungus. *G. carpigenum* is a true *Glœosporium* with no setæ and the fruit borne in isolated pustules. The spores are also much smaller than those of the cotton fungus. These characters, as will be seen further on, separate the latter from *Glœosporium carpigenum* and the possession of setæ places it in the genus *Colletotrichium.* There seems to be no record of any specific name ever having been given it and I will call it *Colletotrichium gossypii.*†

EXTERNAL APPEARANCE AND EFFECTS ON THE BOLL.

According to Mr. Atkinson, who has observed the disease in the field, the fungus attacks all parts of the plant. It has been sent to us, however, only on the boll, and this description must therefore be limited.

So far as can be judged from specimens that have been picked from

* Since this article was prepared, Professor Atkinson read a paper on the same subject before the Association of American Agricultural Experiment Stations at Champaign, Ill. The work in both cases was entirely independent, except where I have cited Professor Atkinson's authority in regard to the parts of the host plant attacked.—E. A. S.

† *Colletotrichium gossypii*, n. s. On cultivated cotton, may occur on any part of the plant, especially injurious to bolls. Sori orbicular, dark colored, or covered with a pink powder. Acervuli erumpent, distinct only when young. Spores irregularly oblong, usually with a light spot in the center, often acute at one end, colorless singly, flesh-colored in mass, borne on short basidia or long setæ. Basidia colorless varying in length, at least longer than the mature spore, very rarely branched, borne on a stroma of varying thickness, 11–28 x 5μ. Setæ occurring singly or in tufts, more abundant in older specimens, dark brown at base, but nearly colorless at the apex, septate, often irregular in outline, straight or flexuose, rarely branching, often bearing spores. Mycelium septate, intra and intercellular, usually colorless, producing secondary dark colored spores, especially when it has simply the form of a germ tube. Stroma of varying thickness, often penetrating the plant tissues for some distance, becoming dark colored with age or where setæ are borne.

one to five days and sent through the mails, the external appearance and progress of the disease on the boll is as follows:

One or more dark colored spots make their appearance on the green capsule. These increase in size and usually become covered with a flesh-colored powder for a short time. This is likely to disappear later leaving a poorly defined spot from which a blackish discoloration, often showing little spots of the pink powder on its surface, extends over the boll. The black discoloration may reach a considerable extent before the spot becomes pink at all, and judging from the appearance of some of the bolls it would seem as if the black color sometimes appears independently, without the pink spots. The growth of the capsule ceases wherever the discoloration extends; this causes the segments to crack apart through the diseased areas, leaving the half-ripe cotton exposed to the rain and dew as well as to the attacks of numerous insects. The capsule itself loses its power of resisting moisture and often becomes water-soaked and covered by saprophytic fungi. The saprophytic fungi, as well as the fungus causing the disease, often penetrate the cotton mass itself and the exposed portion becomes covered with a pinkish powder or with the white filaments and fruit of the saprophytes. As might be expected under these untoward circumstances, the cotton, and often the seeds as well, decays very quickly, especially if wet weather follows and if the bolls are attacked when young. If, however, they do not become diseased until they are nearly ready to burst open, and the weather remains dry, they may not be materially injured.

BOTANICAL CHARACTERS.

The vegetative portion of the fungus is branching and septate (Fig. 6), usually colorless, but sometimes showing a little darkening of the walls, of varying diameter, but usually about 5 μ. The mycelium penetrates the cells, often showing a constriction where it passes through the walls, with a slight enlargement on one or both sides (Fig. 5.). Frequently a hypha runs along in contact with the wall for some way before it pushes through. The mycelium is exceedingly abundant in the tissues, and sometimes appears to nearly fill the cells. In consequence of its presence the cell contents become disorganized and the cell walls frequently collapse, especially near the surface, where a section through the diseased tissue shows no cavities remaining. The chlorophyll is at first resolved into bright green globular masses, but later all the green color disappears, leaving only a small quantity of disorganized brownish material in the cells.

Anywhere in its course the vegetative mycelium may send off branches which push out to the surface and bear spores at their free ends. A quantity of these are generally sent off close together and become so matted at the surface of the boll that a stroma is formed from which spring the ends of the spore-bearing branches or basidia. This stroma varies very much as regards quantity; it may be a scarcely perceptible layer, or it may extend for some distance above the surface and pene-

trate between the cells for three or more layers (Fig. 3), completely surrounding the discolored cell fragments that remain, probably because the fungus is not able to absorb them. In older specimens the fruit is not borne in distinct pustules, but the epidermis seems to be broken up into flakes and the basidia are borne uniformly or in tufts on the fruiting surface. In the course of from two days to a week after the first basidia and spores are formed the dark brown setæ may be formed among them. They grow out from somewhat enlarged darker cells in the stroma, and are bluntly rounded at first, but become more acute as they grow older. They are frequently enlarged or present other irregularities somewhere along their course, especially near the tip (Fig. 1 *a*). The bases are a very dark brown, but the tips are usually nearly colorless. Under some conditions, especially in a moist atmosphere, the setæ may bear spores at their tips. These spores seem to be somewhat smaller than those borne on the regular basidia, but in artificial cultures the two kinds are indistinguishable. At first the setæ are few, but they increase in number with the age of the fungus, and in some sections the conclusion that the basidia themselves are being transformed into setæ is almost irresistible. In older specimens the setæ appear in large tufts and sometimes branch. It is not infrequently the case that one seta arises from the lower end of another; a beginning of this may be seen in Fig. 1. The amount of stroma is also seen to increase with age, especially beneath the setæ, where it becomes very dark colored. In old specimens the setæ are borne considerably above the basidia, so that the latter line the cavities between them (Fig. 1). The tufts of setæ may even have the appearance of being pushed up and out of the way by the basidia and spores behind them.

The spores are oblong, and usually have a vacuole in the center. Viewed separately under the microscope they are colorless, but in masses they form a salmon-pink powder which gives the color to the spots as already described. They are successively abscised from colorless basidia, which vary greatly in length and may branch when kept excessively moist (Figs. 4–7). Usually the connection between the spore and the basidium becomes smaller until the spore is cut off; but there are cases where the spore falls from the end of the basidium when the septum separating them is half as wide as the basidium itself, which appears truncate after the spore has fallen. The setæ which have borne spores also often have a truncate appearance.

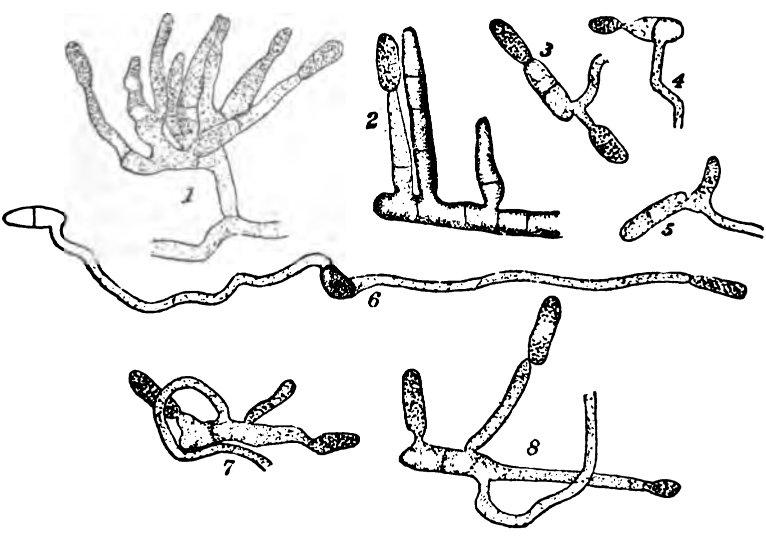
The fungus retains its vitality under very adverse circumstances. Some specimens of diseased bolls were allowed to lie in the heated air of the laboratory for a month or more. The pink spore powder was then entirely washed from the surface, a piece cut out and soaked, and placed under a bell glass. In three days the surface again showed small masses of pink spores that had been produced since the fungus was put under the bell glass.

An attempt was made to grow this fungus in a decoction of hollyhock agar-agar. This was only a partial success, for while spores and setæ

were produced the fungus was evidently in an unfavorable medium and was short-lived. However, some very important results were obtained.

In forty-three hours from the time of sowing, a distinct mycelium had been formed which bore numerous basidia at right angles to its branches and these were already producing spores (Fig. 7 b). Along with these spore-producing branches were others which differed from the basidia and ordinary mycelial branches in being devoid of visible granular contents, and on close inspection seemed to be a trifle darker colored and thicker walled. They sometimes had a septum near the base and were shaped like setæ. Twenty-four hours later there were well developed setæ on the same mycelium that bore the basidia and spores. As the mycelium grew older more setæ made their appearance; but in the moist environment in which it was necessary to keep the artificial substratum nearly all of them bore spores and were even more irregular in appearance than they are in nature.

After the setæ begin to form it is difficult to find basidia and setæ close together. The parts of the mycelium that bear setæ bear nothing else. Septa are often produced in the mycelium at each side of the bases of the setæ and the cell thus formed sometimes grows larger and darker colored than the remainder of the filament, while the threads which bear setæ are often coarser and darker colored throughout. This may explain the dark colored cells at the bases of the tufts of setæ as they occur in nature.



1. Tuft of basidia, with young spores rising from a single thread, showing mode of formation of fruiting surface.
2. Basidium and seta springing from the same mycelial thread.
3, 4, and 5. Spores twenty-four hours in water, showing spores produced by budding.
6. Germinating spore, with germ-tube and secondary spore, which in turn has sent out a germ-tube bearing a spore at the end.
7 and 8. Spores forty-eight hours in water.

Spores were also sown in a decoction of cotton bolls in agar-agar. In this the fungus grew more luxuriantly and rapidly, but was much slower in producing setæ, and when these were first discovered, nearly a week after they were sown, they were already bearing spores. For the first few days only colorless basidia could be found. When a spore was produced on this mycelium it was cut off from the end of the basidium and another formed on the same place, pushing the former one aside. This may occur until there is a large collection of spores at the end of the basidium, the spores that are pushed aside lying adjacent to the second one along their entire length (Fig. 7).

When spores are sown in pure water they exhibit a phenomenon which can scarcely be called anything but budding (Figs. 1–5, 7, 8, p. 103). They become once septate, and while one division sends out a germ tube the other gives rise to another spore, separated from the first only by a short neck. The germ tube also frequently sends out a spore just beyond the point where it leaves the spore (Figs. 3, 5, p. 103). By the time a spore has been two days in water the cell that at first gave rise to the germ tube may also have produced several spores, either by budding or upon a short thread.

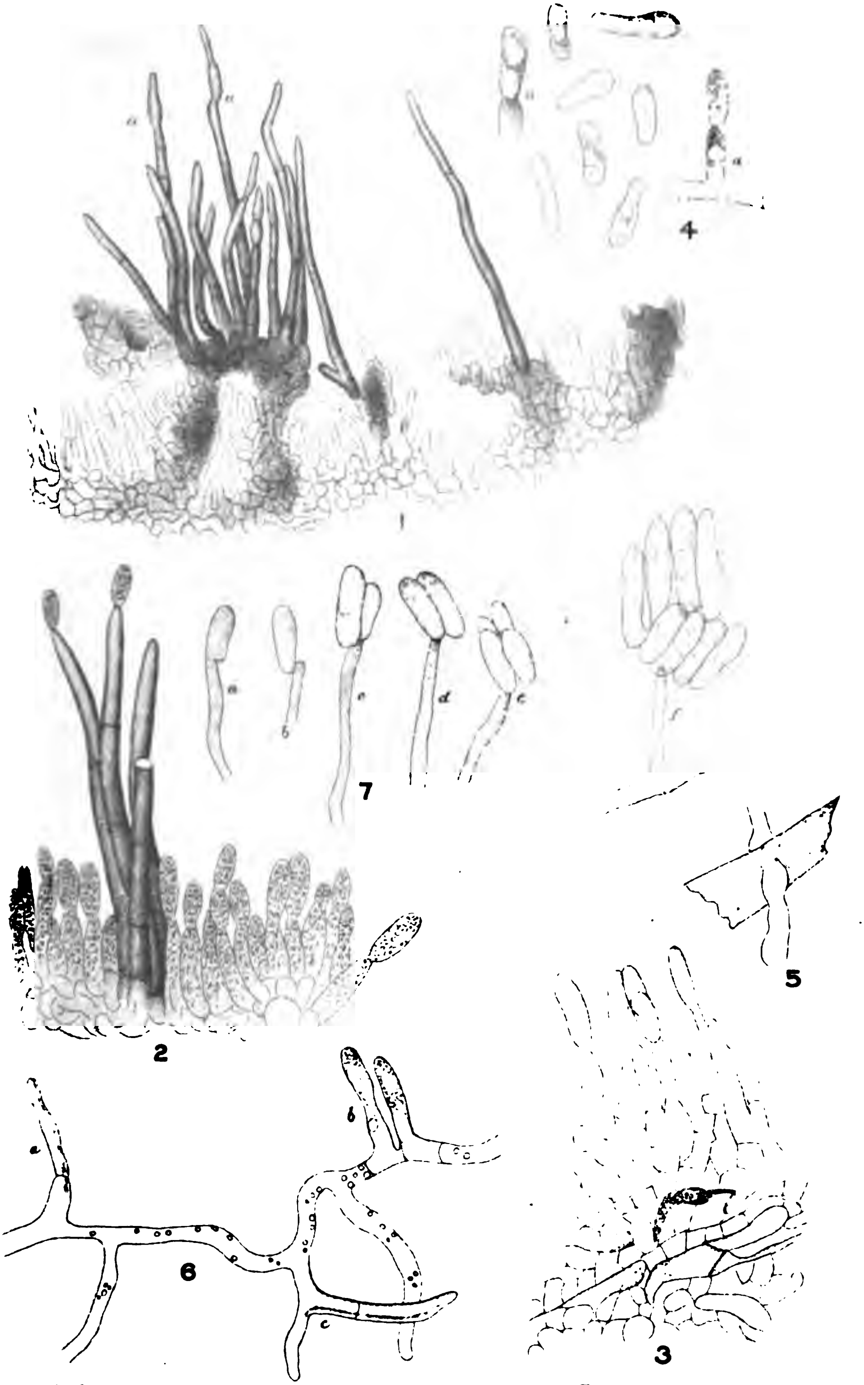
Secondary dark colored spores (Fig. 6, p. 103) are also often produced in great numbers both when the spores are germinated in water and in nutritive media. In the latter they are sometimes so abundant as to give the mycelium a dark color when seen by the naked eye. These bodies are usually regular at first, but become very irregularly lobed and even reproduce themselves by constriction. They also give rise to other mycelial filaments. I do not understand their special function.

GENERAL NOTES.

Just how long the disease has existed or has been a source of trouble to cotton growers can not well be ascertained; but those who have written us concerning it speak of it as new, and it is safe to say that it has greatly increased in destructiveness during the last three years and has now become a source of danger to the cotton industry.

It was first brought to our attention in the summer of 1888 by a letter from a cotton grower in Louisiana. Last year, we received no complaints in regard to it, but during the last few months repeated inquiries have been sent in, and in two cases, one from Alabama and one from Louisiana, it is reported as destroying 75 per cent. of the crop. In general, however, it seems to destroy from 10 to 25 per cent. The disease is evidently not a new one, as a specimen dating back five or six years has been found in the Department herbarium. In this case, however, only a saprophytic fungus which had nearly overgrown the true cause of the trouble was named on the label.

It seems to have appeared at first on the improved varieties and is worse in wet seasons. That it is widespread is evidenced by the fact



E.A.S.del.

SOUTHWORTH ON ANTHRACNOSE OF COTTON.

Colletotrichum gossypii, n. s.

that it has been reported to us from Arkansas, Louisiana, Indian Territory, and Mississippi.

From the nature of the disease there is every reason to fear that it will be very difficult to prevent by fungicides. Anthracnose of the grape is more obstinate than black-rot, and no well defined, certain remedy is yet known for it. The treatment of anthracnose of beans and melons has been attempted on a small scale and has failed completely. The hollyhock disease has been only partially prevented by the use of fungicides that would have succeeded perfectly with black-rot of grapes or leaf-blight of pear. In some of these cases, however, a partial success has been attained and the indications are that the proper use of Bordeaux mixture may finally conquer even this type of fungus.

The vitality of the fungus as shown by its reviving after drying, and the power of the spores to reproduce themselves, are very sure indications of one mode of preventive treatment, viz, the removal from the field of all diseased bolls as soon as possible. A worthless boll will be likely to produce fresh spores with every rain, and if left over winter in the field will probably prove a source of infection the following season, for each spore is capable of infecting a fresh boll. One infection experiment was made on three healthy bolls. The spores were inserted in a cut and the fungus was produced in great quantities all around the cut. The value of this experimment was lessened by the fact that the fungus also appeared on one of the check bolls and that all were taken from a field in which the disease was present. The fact, however, that on the infected bolls the fungus was confined to the vicinity of the cuts is evidence that it was caused by the inserted spores.

Plans are being made to test the value of fungicides in checking this disease during the next cotton-growing season.

EXPLANATION OF PLATE.

Colletotrichium gossypii, n. s.

Fig. 1. Section through old fruiting layer, showing the setæ borne on dark-colored cells, above the level of the basidia; *a a*, enlargements of setæ near the end. X 360.

Fig. 2. Section through younger portion of fruiting layer. Two setæ bearing spores. X 600.

Fig. 3. Section showing stroma mixed with tissues of the boll. X 800.

Fig. 4. Spores; *a a*, borne on basidia. X 600.

Fig. 5. Filiament of mycelium passing through cell wall. X 800.

Fig. 6. Portion of artificial mycelium bearing setæ at *a* and *c*, and at *b* basidium with immature spore. X 600.

Fig. 7. Different stages in the formation of spores in artificial culture. X 600.

PERENNIAL MYCELIUM OF THE FUNGUS OF BLACKBERRY RUST.*

Plates V, VI.

By F. C. Newcombe.

In May of the present year, at the suggestion of Mr. Galloway, a plant of *Rubus villosus* affected with *Cæoma nitens*, Schw. was examined with a view to ascertaining whether there is a perennial mycelium.

A shoot of the blackberry was selected whose lowest leaf bearing the rust was 16 centimeters from the rooting portion of the stem. Beginning with the leaf, cross and longitudinal sections were made, at intervals of 2 centimeters, down to the roots.

At every place of section the characteristic mycelium was found. In one instance the mycelium was observed in the medullary rays; in every other case in the pith only. It is septate, intercellular, and coarsely granular. It looks active and vigorous in the old stem as well as in the green shoot. But the most striking part of it is the haustoria. These are found of the same appearance in leaf, green shoot, and old stem. Penetrating the cell wall by a narrow neck, in the cell-lumen a haustorium expands to a large, lobed and knotted, club-shaped body whose diameter exceeds that of the mycelial filament and whose length frequently attains the transverse diameter of the host cell. In longitudinal sections the mycelium can be followed for long distances in the direction of the shoot axis, not often branching laterally, but sending its great haustoria in all directions into the adjacent cells of the host. Not infrequently the mycelium is seen to form a pseudoparenchyma in the intercellular spaces.

These observations were repeated on fresh material gathered near Ann Arbor the latter part of June.

NOTE BY B. T. GALLOWAY.

Mr. Newcombe's observations have an important bearing on the treatment of blackberry rust, as they indicate that no direct benefit would result from the application of fungicides. Some writers† have claimed that the fungus does not live over winter in the root and stems, and if this were true it would seem possible to prevent the disease by the timely application of fungicides. Field experiments have shown that such applications, no matter how carefully made, have little effect so far as diminishing the amount of rust is concerned.

It is obvious that the immense number of spores, which form the reddish powder so familiar to every one, plays an important part in the life history of the fungus, and by destroying these spores, spraying may, indirectly, result beneficially. It is doubtful, however, if spraying with this object only in view will pay in the end. After all, it seems that

* *Cæoma nitens*, Schw.

† Burrill, Prairie Farmer. 1885, p. 762. Seymour, Rept. State Hort. Soc. Minn 1886, p. 214.

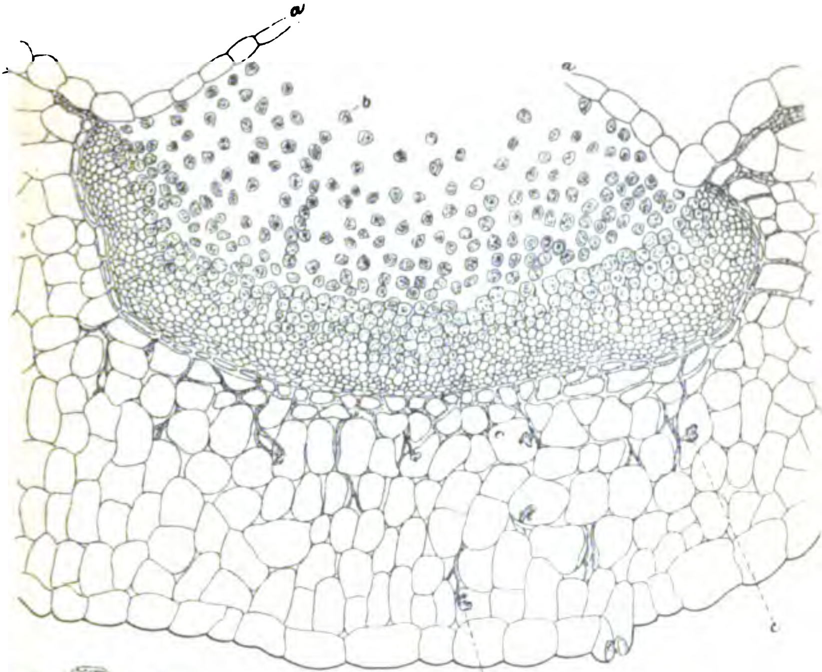


FIG. 1

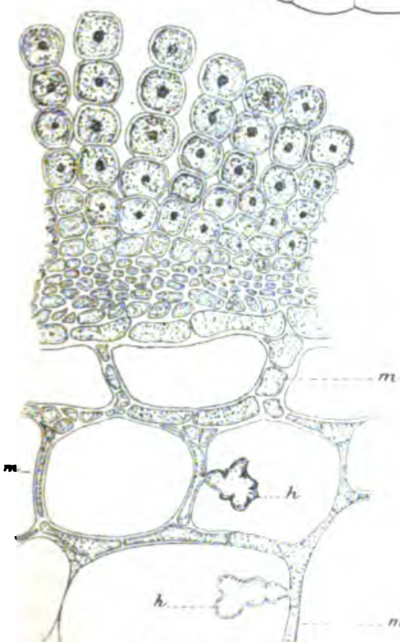


FIG. 2

FIG. 3

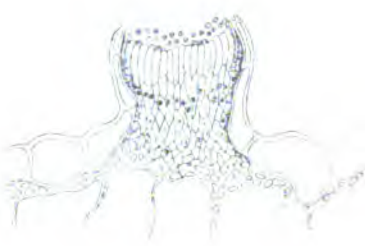
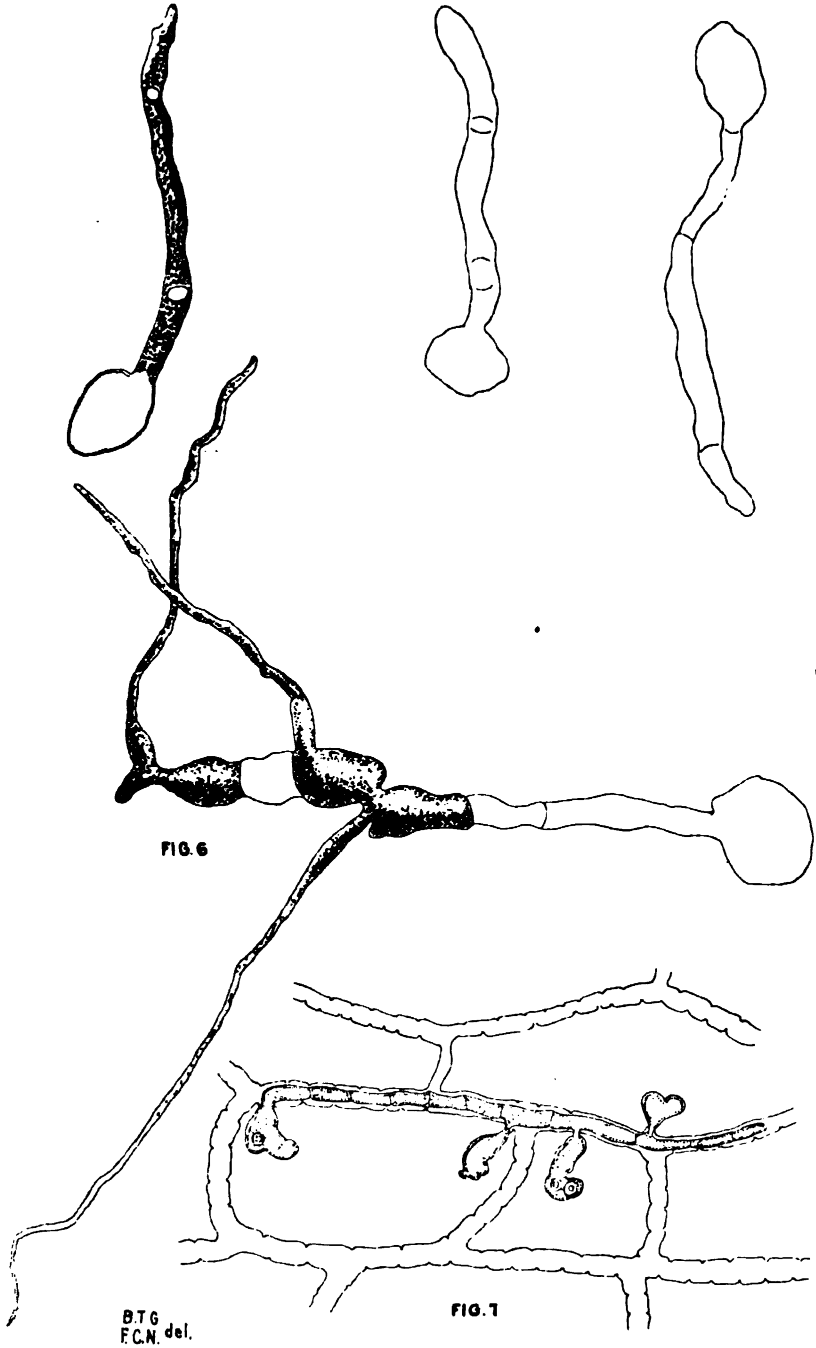


FIG. 4

F.C.N. del.

NEWCOMB ON BLACKBERRY RUST.

Cæoma nitens. Schw.



Newcomb and Galloway on Blackberry Rust.

Caeoma nitens. Schw.

the only practical and efficient method of dealing with this pest is the old one of grubbing out the affected plants as soon as they are noticed. It would be well, also, to discard those varieties known to be subject to the trouble.

EXPLANATION OF PLATE.

BLACKBERRY RUST (*Cæoma nitens*, Schw.).

Fig. 1. Section through portion of leaf affected with rust; *a a*, ruptured epidermis showing below at *b* the mass of spores; *c c*, haustoria. By means of these the fungus draws its nourishment from the cells. X 100. Newcombe.
Fig. 2. Part of section more highly magnified; *m m m*, mycelium surrounding cells of the host; *h h*, haustoria projecting within the cells. X 300. Newcombe.
Fig. 3. Spores. X 600. Newcombe.
Fig. 4. Section through spermogonium. X 300. Newcombe.
Fig. 5. Spores germinating; 24 hours in water. X 250. Galloway.
Fig. 6. Spore germinating; 60 hours in water X 300. Galloway.
Fig. 7. Section through piece of old underground stem, showing perennial mycelium and haustoria. X 300. Newcombe.

FIELD NOTES—1890.

By Erwin F. Smith.

The field naturalist often discovers interesting phenomena not immediately related to his own work—phenomena too fragmentary to be worked up separately, and yet sometimes of much value to others if accurately observed and duly recorded. Such must be my apology for the greater part of the following "notes by the way."

PEACH LEAF CURL.*

Heretofore, in this country, California orchards are the only ones that have been seriously affected by this widely distributed fungus. This spring, however, it caused great injury in certain districts east of the Mississippi River, and was more than usually prevalent in all the principal peach regions of the eastern United States. It was most destructive in central Michigan and western New York, defoliating trees by the thousand in both localities. By the last of June the fungus had nearly disappeared, and the trees had partially recovered and were clothed with a second crop of leaves. But even in July the effects were plainly visible in enfeebled growths, yellowish foliage, and stunted fruits. Certain varieties suffered much worse than others, *e. g.*, Crawford's Early. It seemed to me it would take some of the trees several years to recover.

In Delaware and peninsular Maryland the fungus was unusually common, but the orchards were not defoliated nor badly attacked. I also observed traces of the disease in Georgia in midsummer, but it did not appear to have attracted attention or caused serious injury.

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* *Taphrina deformans*, Tul.

During 1887, 1888, and 1889, this fungus was rare in the great peach region between the Chesapeake and Delaware Bays. Often weeks passed without my seeing a single affected leaf, although I spent much of my time in the orchards. This struck me the more forcibly because in Michigan I had formerly observed the curl to be common every spring. This season, on the contrary, it could be collected in any peninsular orchard. In one only, however, did I find it serious. This was an old, abandoned orchard in sod ground, pastured. Here in May nearly every leaf was white, thick, and distorted, and many were falling. At a distance the foliage was not green, but yellowish white. Younger cultivated orchards on the same farm were nearly free.

PLUM TAPHRINA.

In Maryland and Georgia this disease was also very prevalent on *Prunus Chicasa* and its cultivated varieties. I have been accustomed to call this fungus *T. pruni*, but the injuries differ somewhat from those I have seen on *Prunus Americana* in the North and West. This fungus is much more inclined to thicken, distort, and unite the leaves and growing shoots. The "plum pockets" are also absent. The fruits often suffer, but the fungus generally attacks only one side, forming a hard, solid spot, which ripens imperfectly. From what I saw in the plum orchards of Georgia, and was told, this fungus is an enemy of some importance in that region. Is it specifically distinct from the pocket forming sort?

PLUM BLIGHT.

A peculiar disease, now prevalent several years, in a large plum orchard of native sorts at Griffin, Ga., deserves further study. This disease destroys large branches or whole trees in midsummer in the course of a few weeks. I saw many fine trees of bearing age entirely ruined. The foliage was drying up as if scorched, or as if the limb or body had been girdled. No fungous or insect enemies were observed, and there were no mechanical injuries. The surface bark on the trunk and base of the main limbs was smooth, unbroken, and usually normal in appearance, but upon cutting into it I always found large dead patches which sometimes entirely girdled the trunk or branch. These were often several inches wide by 1 or 2 feet long. Evidently the sudden drying and death of the remoter parts is due to interference in the circulation brought about by the presence of these bark injuries. Their origin, however, is still a mystery. There did not appear to be any injuries below ground. Indeed the injured trees usually sprout again vigorously from the earth.

The loss this year in an orchard of about 6,000 bearing trees amounted to more than 5 per cent. The owner said 10 per cent. The loss last year was nearly as great.

APPLE BLIGHT.*

Never before have I seen this disease one tenth part as destructive. In middle and north Georgia the apple trees were badly spotted by it. The injury was not confined to twigs, but affected branches of several years' growth, greatly injuring next year's fruit prospect. The disease was also common in Pennsylvania, where in other years I have found it common, although confined principally to the twigs. In Michigan it was not seen. In Kansas it was worse even than in Georgia. At Manhattan I was shown several young and thrifty orchards of bearing age which had been sadly injured. The attack began in 1889 and continued this year with increasing severity. The disease was not confined to twigs, but often destroyed large limbs and in some cases one-half or even the whole of the tree, as in pear blight. The owner was in despair. Certain varieties were noticeably worse injured than others. This was found to be true for different orchards and both years. Certain sorts escaped almost entirely.

PEAR-LEAF BLIGHT.†

In Dr. W. S. Maxwell's orchards the Lawrence and Bartlett pears in *sod* ground were very slightly attacked. They held their foliage practically intact until October 15. The cultivated trees were badly affected and shed their foliage early, except Keifer, which did not suffer. I observed this fungus at Still Pond, Md., in 1887, in these same orchards and elsewhere, and also in other parts of the peninsula, but it was not destructive and was not then considered of any consequence by any of the pear growers. Now they are all talking about it.

This year quince and pear orchards all over the Delaware and Chesapeake peninsula were seriously defoliated, and, as a consequence, were quite commonly in second leafage and blossom in October. The injury last year was also very great, amounting in some large orchards to an almost total loss of the crop.

BLACK ROT.‡

In Georgia and Kansas the summer was hot and dry. Vineyards in both States ripened a large and fine crop of fruit, which was almost free from rot. Enough *Læstadia* could be found for specimens, and the same was true for *Peronospora viticola*, but neither did any injury.

In Delaware there was also a long drouth in midsummer and black rot was not seriously destructive.

VINE BLIGHT.§

In good soil in one corner of a fine bearing vineyard near Griffin, Ga., twenty-five or thirty thrifty vines suddenly sickened in midsummer and

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* *Bacillus amylovorus*, (Burrill) Trev.

† *Entomosporium maculatum*, Lév.

‡ *Læstadia Bidwelli*, (Ell.) V. and R.

§ Later this blight was attributed to lightning, by the owner and others, who said lightning had also caused a similar appearance in the cotton fields.

died, in whole or part, in course of a few weeks, without apparent cause. The foliage lost color and wilted, the clusters shriveled, and the canes turned black. No fungous or insect enemies could be seen.

The vines were trained up on stakes and the vineyard had received proper care and cultivation. The soil was well drained upland. The cases were not all in one spot, but scattered about. The malady in its sudden appearance and destructive nature called to mind the mysterious vine disease of California, but did not agree with it in all particulars. At my suggestion the vines were promptly removed and destroyed.

BROWN ROT OF THE PEACH.*

Owing to the phenomenal scarcity of stone fruits in peach districts east of the Mississippi, this fungus was rare, except on old fruits. I saw it once at Lansing, Mich., on nascent plum shoots, but not elsewhere.

PEACH YELLOWS.

In southwestern Michigan there was an increase of the disease around Fennville, but not elsewhere, so far as I could hear or observe.

On the Delaware and Chesapeake peninsula this disease was worse than any previous year. The marked diminution of new cases in 1889 was coincident with a partial failure of the crop. It therefore seemed possible that here might be a clue to the cause of the disease. This year, however, with an entire failure of the crop the number of new cases were in excess of those in 1886, 1887, or even 1888, when the orchards bore most abundantly. Fruit or no fruit, the disease increases.

The cases by years in four representative Delaware orchards (my own count) are as follows:

Year.	Weather in summer.	Cases.			
		30 acres set in 1882.	10 acres set in 1885.	2 acres set in 1884.	10 acres set in 1884.
1887	Wet	*260	†32	†36	†27
1888	Dry	314	71	47	54
1889	Wet	255	63	6	37
1890	Dry	856	118	90	87

* A very few cases belong to 1886 when the disease first appeared. † First cases.

THE PEACH ROSETTE.

A new peach disease, or an old one in a new form, has made its appearance in Georgia and Kansas and bids fair to become very serious. One Kansas orchard was destroyed in two years, and certain Georgia orchards have suffered almost as badly. In some particulars this disease is identical with peach yellows; in others it differs somewhat. The disease occurs also in plums, wild and cultivated, and is equally destructive. A full account is reserved for separate consideration.

* *Monilia fructigena*, P.

THE RELATIONSHIP OF PUCCINIA AND PHRAGMIDIUM.

By Prof. G. de Lagerheim.

As a distinctive difference between Puccinia and Phragmidium, Tulasne* asserts that the teleutospores of the first genus are only provided with one germ pore, while those of the second possess several which are equatorially arranged. Since then, however, Dietel † has shown that this is not the case in all Phragmidiums, but that in *Ph. obtusum*, Winter, each cell of the teleutospore is provided with only one germ pore situated at the upper end of the cell exactly as in the genus Puccinia. *Ph. albidum*, Ludwig, appears to form a transition between the two types.‡ It should also be mentioned that in *Ph. Barnardii*, Plowright & Winter, and in *Ph. carbonarium*, Winter, the end cell is provided with an apical pore. Besides these characteristics, which are, as we see, unreliable, *Phragmidium* is distinguished from *Puccinia* by the number of cells in its teleutospores and by the different structure of its *Æcidia*. But in several Puccinias we occasionally find many-celled teleutospores, and therefore this character is not constant. On the contrary the difference in the structure of the æcidium appears to be a constant mark of distinction. The æcidium of Puccinia is provided with a pseudo-peridium, while that of Phragmidium is not; and in the latter the spores are cut off from basidia and surrounded only by a row of paraphyses as in the genus Melampsora. §

In the above-mentioned work Dietel has attempted to establish the the fact that *Phragmidium* is more closely related to *Chrysomyxa* than to *Puccinia*. But in comparing the two genera which he considers to be related he has forgotten to notice the difference existing between their æcidia and uredo stages. As has been said, the æcidium of *Phragmidium* has no pseudo-peridium, while one is present in the æcidium of *Chrysomyxa*. The structure of the uredospores of the two genera differs even more. In *Phragmidium*, as in *Puccinia* and *Uromyces*, they arise singly at the end of a mycelial thread, while on the other hand in *Chrysomyxa*, as in *Coleosporium*, they are borne in rows. I am therefore inclined to believe in a closer relationship between *Puccinia* and *Phragmidium* than between *Chrysomyxa* and *Phragmidium*. This supposed relationship would become still clearer if one could find a *Phragmidium* with a Puccinia-æcidium or a *Puccinia* with a Phragmidium-æcidium or with several equatorial germ pores. We can probably regard the genus *Rostrupia*‖ as a *Phragmidium* with a Puccinia-æcidium. The teleutospores

* Ann. de Sci. Nat. Ser. 4, t. II, p. 146.

† Beitrage zur Morphologie und Biologie der Uredineen t. II, 9. Figs. 3–7. (Cassel, 1887.)

‡ Compare Dietel, l. c., t. II, Fig. 10, and Müller Die Rostpilze der Rosa und Rubusarten und die auf ihnen vorkommenden Parasiten t. I, fig. 9 (Berlin, 1886).

§ The genus *Calyptospora*, Kühn, is not to be united with *Melampsora*, because, as is known, the Calyptospora-æcidia have a pseudo-peridium.

‖ Compare Lagerheim, Sur un nouveau genre d'Urédinieés (Journ. d. Botan., 1889), Paris.

of this genus are as a rule 3–4 celled, and the uredospores are formed in the same way as in Phragmidium (and Puccinia). The æcidia of *Rostrupia* are unfortunately not known, but judging from its great similarity to certain grass inhabiting Puccinias it is very probable that the æcidia are formed as in *Puccinia* and *Uromyces*. A Puccinia with a Phragmidium-æcidium is not known, although it is not impossible that such a one exists. On the other hand there is one Puccinia, or perhaps several, which shows a condition of the germ pores typical for *Phragmidium.*

There are several *Uredineæ* on Barberry species. Besides the well known æcidium of *Puccinia poculiformis*, Wettstein (*P. graminis*, Persoon), there probably occur three æcidia upon Barberry, namely, *Ae. Magelhænicum*, Berkeley,* æcidium of *P. berberidis*, Montagne, and an æcidium which appears to belong to a *Diorchidium* frequent around Quito on *Berberis glauca.* The genus *Uromyces* is represented on Berberis (Mahonia) by one species, *U. sanguineus.* Besides the above mentioned, *P. berberis*, Mont., two Puccinias, *P. mirabilissima*, Pk. and *P. antarctica*, Speggazzini, have been observed on Barberry. Finally two uredo forms are found on Berberis, namely, *U. æcidiiformis*, Speggazzini and *U. antarctica*, Speggazzini.

Puccinia mirabilissima was described by Peck in the Botanical Gazette for 1881, p. 226. Tracy and Galloway gave further information concerning it in the Botanical Gazette for 1888, p. 126, and De Toni gives the following diagnosis of the species (Syll. Ured., p. 620).

Maculis late purpureis 3–4 millimeter diameter, leniter incrassatulis, pseudoperidiis hypogenis, longis, pallide flavis, margine grosse laceratis; æcidiosporis subglobosis, 15-20 μ diameter, tuberculatis; maculis parvis, punctiformibus vel majusculis subrotundisque, superne atris vel atrobrunneis; soris hypophyllis, paucis, minutis pallide rufescenti—brunneis; uredosporis subglobosis, obovatis vel piriformibus, obtusis, minutissime rugulosis; 22–33 by 20–23 μ pedicello hyalino, dein deciduo; teleutosporis immixtis, ellipticis, obtusis, ad septum constrictis, subtiliter rugosis, 30-32 by 22–25 μ pedicello longissimo hyalino fultis.

The species is found in several places in the United States on the leaves of *Berberis repens*, and has been distributed in Ellis's North American Fungi, No. 1451, and Rabenhorst-Winter-Pazschke's Fungi Europaei, No. 3619.

In the following I will give the results of my investigations with specimens distributed in Fungi Europæi. They were collected at Thompson Falls, Montana, September, 1884, by Seymour, and in Sierra Nevada, California, May, 1886, by Harkness. Uredo and teleutospores, but no æcidia, were present; the uredospores from the Montana specimens were more or less ovate, those from California piriform.† When treated with warm potash or lactic acid the epispore swelled up so

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**Aecidium graveolens*, Shuttleworth, is really identical with *Ae. Magelhænicum* Berkeley.

† Compare Lagerhiem "L'acide lactique, excellent agent pour l'etude des champignons secs" (Rev. Mycol. No. 42). Toulouse. 1889.

that it could easily be shown to consist of three layers. The outer layer is very thin, colorless, and covered with fine warts; the middle layer is the thickest and is yellowish and smooth; the inner layer appears tolerably firm and is also yellowish and smooth. The uredospore is provided with from three to four equatorial germ pores, and the membrane is not equally thick everywhere, but is not especially thickened at the base of the spore. Treated in the same manner the epispore of the teleutospores showed the same three layers; the warts on the outer layer are somewhat larger and do not stand so close together as on the uredospores. The teleutospores are characterized by a long hyaline pedicel which breaks off at the base and remains in connection with the spore. The pedicel tapers below and is hollow in the lower portion. It is not perfectly smooth everywhere, but a small wart occurs here and there. Probably Peck called this species *mirabilissima* on account of the strikingly long pedicel, but it deserves this epithet in a still higher degree on account of another peculiarity that has been hitherto overlooked. One of the main characters of the genus *Puccinia* is, as we know, that each cell of the teleutospore is provided with but one germ pore which can have different positions, but in *P. mirabilissima* this is not the case, for here is each cell of the teleutospore with two opposite germ pores. These show plainly when the spores are treated as above mentioned. In this respect *P. mirabilissima* varies from all other Puccinias that have been carefully observed, and even in this peculiarity I see a point of union between the genera *Puccinia* and *Phragmidium*. It would be of interest to study the germination of this peculiar species, and it is to be hoped that some one of my North American colleagues, to whom living specimens are accessible, will undertake it.

QUITO, ECUADOR.

NOTES.

A NEW PEAR DISEASE.

Something over a year ago we received from one of our correspondents in southern Alabama a number of pear branches affected in a peculiar manner. In a letter sent with the specimens our correspondent described the disease as follows:

> The disease appears in the form of spots on the trunk of the tree, always at a dormant bud, also on the branches at the base of another branch or fruit spur. The spots when first noticed were about one-quarter of an inch in diameter, but soon increased to four or five times this size. They are nearly round and are surrounded with whitish uneven edges. When one-half an inch or more in diameter the affected portion becomes depressed and upon cutting into it the bark cambium and a considerable portion of the wood is seen to be brown and dead. In no case has the affection entirely encircled a branch or trunk, but I have no doubt that if allowed to continue it will do so in a short time. I have never seen the disease before and fear it will prove troublesome in my orchard.

Upon examination of the specimens it was found that the disease was due to a fungus known as *Thelephora pedicellata*, Schw. We have this

parasite, for so we must regard it, from New Jersey on oak (*Quercus cocinnea*), Florida on palmetto (*Sabal palmetto*), and Texas on cultivated apples. From this it will be seen that it is not particular as to hosts or locality. There is no doubt that on trees having such soft, tender bark as the pear and apple the fungus will readily obtain a foothold and prove a very serious enemy. An allied species (*T. perdix*, Hartig) occurs in Europe on oak, causing what is known as "partridge wood." In this case the wood becomes a deep brown; then white spots appear upon these discolorations, giving to the affected parts a mottled appearance. hence the name.

To our correspondent's inquiries concerning the cause of the disease and its treatment we gave in reply to the first question substantially what is stated in the foregoing remarks, suggesting by way of an answer to the inquiries concerning treatment that he cut out all the diseased wood and, after washing the wounds thoroughly with a saturated solution of sulphate of iron or copperas, apply grafting wax or something similar. Our suggestions were complied with to the letter, excepting that a coat of shellac dissolved in alcohol was used instead of grafting wax.

A few days ago we received a note from our correspondent saying that the treatment had proved entirely successful. The wounds healed readily and the trees which a year ago bore every indication of approaching death are now as vigorous as any in his orchard.—B. T. GALLOWAY.

DISEASE OF GERANIUMS.

For a long time we have noticed a disease of geraniums which attacks the stems, causing them to turn black, shrivel, and sometimes become soft and mushy. The trouble is not confined to any particular variety, nor does it seem to be influenced to any great extent by soil or climate. It is a very troublesome thing in greenhouses, especially among cuttings, which it often destroys by the thousand. Cuttings attacked by the disease begin to turn black at the severed end, the discolorations rapidly extending upward until the whole stem is involved. Occasionally the disease stops after an inch or more of the cutting is destroyed: but even if this takes place the plant eventually dies as soon as the supply of nourishment in the green portion is exhausted. Cuttings rooted in the bench are not so apt to suffer from the disease as those immediately potted. The disease is also more troublesome where immature wood is used and when too much water is applied immediately after the cuttings are potted.

Microscopic examination of the diseased tissues has so far revealed nothing in the shape of a fungus excepting where the wood has become soft, where, as might be expected, a number of saprophytic forms occur. Sections through portions of the stem as at *a* Fig. 1, where the disease is actually at work, reveals under the microscope immense numbers of bacteria, in some cases almost filling the cells and often escaping into the water in sufficient numbers to make the latter appear milky.

Cultures made from the diseased wood on gelatine, agar-agar, potato, etc., usually show at the expiration of from 24 to 48 hours numerous colonies of bacteria which are for the most part of one kind, namely, a *Bacillus*.

As yet no inoculations have been made with the organism itself, but the disease has been produced in a number of cases by inoculations directly from diseased wood. Figure 2 shows the result of one of these inoculations, *a* being the point where the knife entered the tissue. The disease is one certainly worthy of careful investigation, as the losses in one establishment last year in this city amounted to over 50 per cent.

FIG. 1.

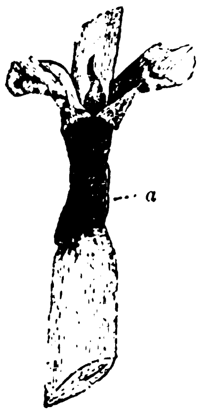

FIG 2.

FIG 3.

Our object in writing this preliminary note is to call the attention of florists and others directly interested in the matter to the work we now have under way and to obtain from them any information bearing on the subject they may consider of value.

A disease which may be the same as the one here referred to has recently been reported from France by Messrs. Prillieux and Delacroix.*

According to these writers *Pelargonium* and potato stems are affected with a malady which causes them to turn black and become rotten. The disease has been transferred from the potato to the *Pelargonium* and vice versa. A *Bacillus*, which the authors believe to be the cause of the trouble and which has received the provisional name of *B. caulicolous*, Pr. and Del., has been found associated with the disease. No mention is made of the disease having been produced by inoculating with the organism, although it is claimed that this can readily be done by direct inoculation.—B. T. GALLOWAY.

ADDITIONAL OBSERVATIONS ON ANTHRACNOSE OF THE HOLLYHOCK.

Since the last issue (Vol. VI, No. 2) of the JOURNAL OF MYCOLOGY some additional facts have come to light concerning the *Colletotrichium* on the hollyhock.

* Comptes Rendus t. CXI, p. 208.

A fungus exactly like it in appearance has been found on *Sida spinosa* by Mr. W. T. Swingle at Manhattan, Kans. Some attempts at producing the disease on hollyhock by the spores from *Sida* have been made, but as far as known they have not been successful. This might easily be accounted for by the lateness of the season and consequent low temperature, and it seems almost certain from a comparison of the fungi that they belong to the same species.

Dr. P. A. Saccardo writes that the fungus is probably not a new species at all, but was described in 1854 by Braun and Caspary as *Steirochæte malvarum* on *Malva* in Europe (Sacc. Syll., IV, 316). The descriptions certainly agree in many respects, but the description in the Sylloge reads, "Conidiis ex pseudostromate immediate (ut videtur) orientibus," and the spore measurements are given as 8–9 x 3–4 μ. In the fungus on hollyhock there was no question as to the spores being borne on basidia and they measured 11–28 x 5 μ. The fact of the spores being borne an basidia may, however, have been overlooked, and as the spores vary greatly anyway, the difference in size is not sufficient reason for making a new species.

After comparing the two descriptions it seems very probable that the fungus must stand as *Colletotrichium malvarum*, (Br. & Casp.).

There also seems to be a possibility that *Steirochæte graminicola*, (Ces) Sacc. may be identical with *Colletotrichium bromi*, Jennings, an undescribed species on *Bromus secalinus*, noted in Bull. 9 of the Texas Experiment Station.—E. A. SOUTHWORTH.

LEPTOTHYRIUM PERICHYMENI, DESM.*

Specimens of what seemed to be this species on *Lonicera*, sent this season from Perry Sound, Ontario, Canada, by Mr. Dearness, have the sporules (pseudo) septate near the lower end and agree accurately with the description and specimens of *Marsonia loniceræ*, Hark., except in being mostly shorter (22—30×7—9μ). European specimens in Thüm. M. U. 1893, Kunze, F. Sel. 591, Linhart 474 and F. G. 4674 do not show any septum, though the F. G. specimens show some indications of one. The European specimens also have the sporules less attenuated below. In the specimen from Dearness and Harkness the lower part of the sporule is so much narrowed as to appear like a stipe or pedicel. The Canadian and Californian specimens are certainly the same and can not be referred to *Marsonia*, as they have a very distinct scutellate perithecium of radiate fibrous texture. We propose to designate the American form as *Leptothyrium perichymeni*, Desm. var. *Americanum*, E. & E.—J. B. ELLIS and B. M. EVERHART.

A NEW USTILAGO FROM FLORIDA.

USTILAGO NEALII, Ell. and Anders., n. s. On *Heteropogon melanocarpa*, Lake City, Fla. Prof. J. C. Neal, collector, 1890.

Attacking the inflorescence. Spore masses firm, blackish brown, fill

*Sacc. Syll. III, p. 626.

ing the ovaries, frequently transforming a whole spikelet into a solid mass of spores enveloped in a whitish to buff-colored tegument. The lower lateral solitary spikelets, when attacked, are changed into irregular roundish knots, or nodules, as large a medium sized pea. Spores roundish, oblong, oval or ovate and variously compressed; contents pale olivaceous, epispore smooth, reddish brown; general color of spore a bright warm brown, slightly olive tinged, 6–10 μ wide, by 6–14 μ long. J. B. ELLIS and F. W. ANDERSON.

REVIEWS OF RECENT LITERATURE.

KELLERMAN, W. A., AND SWINGLE, W. T.—*Preliminary experiments with fungicides for stinking smut of wheat.* Bulletin No. 12.—August, 1890. Botanical Department of the Experiment Station, Kansas State Agricultural College, Manhattan, Kans.

The wisdom of the recent establishment of State experiment stations by the General Government has been called in question in certain quarters. Nevertheless, the stations are here to stay, and their public usefulness becomes more and more apparent, especially after reading such a paper as this from the Kansas station. The results are striking and conclusive, and worth more to the wheat-growers of this country than the cost of all the stations.

In the main these experiments are a repetition and confirmation of those made in Europe by Jensen, Kühn, and others. Fifty-two treatments were given for the prevention of stone smut in wheat (*Tilletia*). The substances experimented with were:

Hot water of various temperatures; lye of different strengths; solutions of copper sulphate with and without lime, and of different strengths; Bordeaux mixtures, full and half strength; eau celeste; solution of sodium hyposulphite, with and without lime, and of different strengths; solution of potassium sulphide, with and without lime, and of different strengths; arsenic; lime; salt; soap; cistern water; chloroform; ether; sulphurous oxide; carbon bisulphide; ammonium hydrate; carbolic acid; sodium sulphate, bicarbonate and carbonate; potassium bichromate; mercuric chloride, and salicylic acid.

Fifty untreated strips, alternating with the treated ones and containing a total of 6,227 square feet, afford the basis for comparisons. The total heads produced on these 50 plats were by actual count 122,432, of which over seventy-one per cent. were smutted. The highest per cent. of smutted heads on any plat was 81.61 per cent.; the lowest was 53.54 per cent. The average number of bushels of sound grain per acre (calculated) on 41 of these plats is only 4.68. By an oversight no calculation was made for the other nine plats, but these were much like the rest, and the average of the fifty could not have varied much from that here given.

Undoubtedly the yield was smaller and the per cent of smut greater owing to the fact that the grain was sowed in November and made a slow and feeble autumn growth. In this connection it is interest-

ing to note that the per cent of smut was greatest on the latest sowings as the experiments of Brefeld would lead us to expect. The wheat was soaked in the fungicides or subjected to their vapors in case of chloroform, etc.

The experiments which proved most successful were as follows:

No. 13. Hot water 131-132° F., 15 minutes. Smutted grains skimmed off.
No. 15. Hot water 132–134° F., 15 minutes. Smutted grains not skimmed off.
No. 21. Copper sulphate, 8 per cent., 24 hours; not limed.
No. 23. Copper sulphate, 8 per cent., 24 hours; limed.
No. 25. Copper sulphate, 5 per cent., 24 hours; not limed.
No. 27. Bordeaux mixture, 36 hours.
No. 29. Bordeaux mixture, half strength, 36 hours.
No. 45. Arsenic, saturated aqueous solution, 24 hours.
No. 57. Copper sulphate, ½ per cent. solution, 24 hours.
No. 87. Potassium bichromate, 5 per cent. solution, 20 hours.

The following table shows at a glance what has been accomplished:

Plot.	Heads smutted.	Bushels of sound grain (calculated.)
	Per cent.	*Per acre*
Average of the untreated	71.29	4.68
No. 13	0.13	14.37
No. 15	0.82	15.36
No. 21	0.36	....
No. 23	0.31	12.52
No. 25	0.00	13.54
No. 27	0.00	....
No. 29	0.06	....
No. 45	1.09	13.75
No. 57	0.74	....
No. 87	0.00	17.01

The authors recommend the Jensen or hot-water method as the best on the whole. This treatment did not destroy quite all the smut, but it killed none of the wheat grains, and gave the largest yield except No. 87, which was only a small plot. Full directions are given for making this treatment.

The bulletin shows evidence of unusual care in preparation and a visit to the station during the progress of the experiment led me to believe that particular attention was given to all the details of the experiment, which is one involving a very great amount of painstaking labor. The graphic illustrations deserve special commendation.—ERWIN F. SMITH.

NEW SPECIES OF UREDINEÆ AND USTILAGINEÆ.

By J. B. ELLIS AND B. M. EVERHART.

SCHRŒTERIA ANNULATA, n. s. In ovaries of *Andropogon annulatus* from India (Herb. of S. M. Tracy). Mass of spores brownish black, pulverulent. Spores in twos or occasionally in threes, flattened on the line of contact, hyaline and 12–15μ diameter at first, becoming brown and separating into two distinct spores 7–10μ diameter. Epispore smooth or nearly so.

SCHIZONELLA SUBTRIFIDA, n. s. N. A. F. 2266. In flowering heads of *Cirsium ochrocentrum*. Wet Mountain Valley, Colo., July 25, 1888. Rev. C. H. Demetrio. No. 162. Spores violet or purple brown, subglobose or elliptical, soon becoming uniseptate and finally separating into two hemispherical segments. Epispore strongly tubercular-roughened, 12–20 by 12–16μ. Occasionally spores are seen with a triradiate septum much the same as in the spores of *Triphragmium clavellosum*, Berk., and in this case the spore separates into three parts instead of two, but the great majority of the spores are bifid. The fungus occupies the whole interior of the flowering heads, which become hollow and abortive.

USTILAGO DIPLOSPORA, n. s. In ovaries of *Panicum sanguinale*, Holly Springs, Miss., September 1890. Tracy No. 1551. Mass of spores dark brown. Spores of two kinds, the smaller ones globose, rough, brown, 7–8μ diameter, the larger ones 12–15μ smooth, globose, pale, nearly hyaline.

USTILAGO MONTANIENSIS, n. s. On *Muhlenbergia glomerata*, Sand Coulee, Mont., December 1887. Leg. Anderson. In the inflorescence which is rendered abortive and remains inclosed in the sheaths of the leaves. Mass of spores dark brown, nearly black. Spores subglobose, 10–14μ diameter or oblong or ovate oblong, 12–16 by 10–12μ epispore subtuberculose-reticulated, pale-brown.

ÆCIDIUM MICROPUNCTUM, n. s. On *Castilleia* from Pine Ridge, Nebr., July, 1890. Prof. T. A. Williams. Æcidia gregarious in oblong groups or patches 3–5^{mm} long and 2–3^{mm} wide, small ($\frac{1}{3}^{mm}$), sunk in the substance of the leaf, which is only slightly thickened, border narrow, erect, sublacerate. Spores subglobose or suboblong, more or less angular, smooth, 18–20μ in the longer diameter, orange yellow, approaching orange red.

ÆCIDIUM EUROTIÆ, n. s. On *Eurotia lanata*, Helena, Mont., Rev. F. D. Kelsey, June 1889, Com. F. W. Anderson. No. 514. *Æcidia hypophyllous*, arranged along each side of the midrib, short cylindrical, about $\frac{3}{4}^{mm}$ high and $\frac{1}{2}^{mm}$ broad, with a thin, suberect, sublacerated margin. Spores orange-yellow, subglobose, smooth, 15–20μ diameter.

UROMYCES SCABER, n. s. III. On leaves of some grass. Swift Creek, Custer County, Colo., October 1888. Cockerell, No. 62. Sori elliptical, bare, dark chestnut color, nearly black, $\frac{1}{2}$–1^{mm} long by $\frac{1}{2}$–$\frac{3}{4}^{mm}$ wide, pulvinate, gregarious or subconfluent. Spores globose 20–22μ or elliptical 22–25 by 20–22μ, densely echinate-scabrous, epispore scarcely thickened at the apex, pedicels subequal, hyaline, 40–50 by 4.

PUCCINIA ARABICOLA., n. s. On *Arabis* sp. Ottawa, Canada. Dr. J. Macoun, I and III.

I. Æcidia amphigenous, collected in patches or groups 2–4^{mm} across, hemispheric and closed at first, then open, small, shallow, margin slightly spreading and minutely denticulate. The spores having mostly disappeared from the rather scanty specimens, we can not now accurately describe them.

III. Sori amphigenous, scattered, small, black-brown, covered at first

by the lead-colored cuticle which is at length ruptured and forms a border around the margin. Spores elliptical, oblong or obovate, rounded and thickened above, smooth, constricted at the septum, 27–40 by 20–23μ on rather stout pedicels about as long as the spores. This is quite distinct from *P. thlaspeos*, Schubert, which has the sori paler and hypophyllous and has no æcidium. *P. aberrans* (N. A. F. 1834) is also different from this.

PUCCINIA ARALIÆ, n. s. On ginseng (*Panax trifolium*), Massachusetts, May, 1888, Miss C. H. Clark and M. C. Carter, III. Parts attacked more or less distorted. Sori caulicolous and foliicolous, minute, clustered in tufts 1–2^{mm} across, naked and of a dark-brown or nearly black color, not on any definite spots though the affected leaves turn more or less distinctly light yellow, the yellow area occupying a large part of the leaf. On some of the leaves the sori were placed opposite on each side of the leaf, but in this case those on the upper surface were smaller. Spores oblong or oblong-elliptical, with fine, granular contents, and granular-roughened, pale-brown epispore scarcely thickened at the apex, which is either regularly rounded and obtuse or capped with a small hyaline papilla. Scarcely constricted, 25–35 by 15–20μ on rather slender pedicels, about as long as or a little longer than the spore itself.

PUCCINIA XANTHIIFOLIA, n. s. (*P. compositarum*, Schlect. in N. A. F. 2252.) On leaves of *Iva xanthiifolia*, Manhattan, Kans., October, 1888. Dr. W. A. Kellerman. I and II not seen. III. Sori hypophyllous scattered, bare, black, $\frac{1}{2}$–1^{mm} diameter, tuberculiform, compact. Teleuto spores, elliptical or obovate-elliptical, smooth, rounded and thickened at the apex and mostly with a distinct papilla, constricted at the septum, deeply colored 35–45 by 18–23μ on long (70–80μ), slender, subpersistent pedicels. This is a very different thing from *P. compositarum*, for which, by some inexplicable error, it was distributed in N. A. F. *P. intermixta*, Pk., according to authentic specimens, is also very distinct from this.*

PUCCINIA CONSIMILIS, n. s. On leaves of *Sisymbrium linifolium*. Helena, Mont., May, 1889. Rev. F. D. Kelsey, No. 53. I and III. Hypophyllous. Æcidia covering the greater part of the lower surface of the leaf. Shallow, soon open, margin sublacerate-toothed and narrowly reflexed. Æcidiospores pale yellow, subglobose or subovate, smooth, 20–23μ diameter.

III. Sori minute, $\frac{1}{2}$^{mm} diameter, crowded but not confluent and like the æcidia occupying the greater part of the lower surface of the leaf. chestnut brown, closely surrounded by the ruptured epidermis, but naked above almost from the first. Teleutospores oblong-obovate, constricted, 25–42 by 18–22μ, thickened at the apex, with or without a papilla, which when present is either central or oblique, upper cell mostly broader and darker, lower cell also generally rounded at the base, pedicels as long as or longer than the spores.

* *Puccinia bigeloviæ*, E. and E., N. A. F. 2248, is on *Gutierrezia euthamia*, and may be only a form of *P. tanaceti*.

I and III occur together on the same leaf. The spermogonia were not observed. Possiby the *Æcidium* may be *Æcid. monoicum*, Pk., but the color of the spores is different and the cups are open almost from the first. The manner of growth is the same.

NOTES ON CERTAIN UREDINEÆ AND USTILAGINEÆ.

BY F. W. ANDERSON.

ÆCIDIUM CRASSUM, Pers., *Æcidium rhamni*, Pers., and *Æcidium pulcherrimum*, Ravenel, are identical, and are considered to be I of *Puccinia coronata*, Corda. In Sacc. Sylloge *Æcidium pulcherrimum* is retained, probably inadvertently, in specific rank, although it plainly belongs as above. No. 933 of de Thümen's Mycotheca Universalis, given as *Æcidium rhamni*, Persoon, is identical with Ravenel's specimen of *Æcidium pulcherrimum*.

NUMBER 1003 of Ellis's N. A. F. is *Æcidium ranunculacearum*, DC. But *b* of this number is *Æcidium ranunculi*, of Schweinitz. The most available, and as it appears to me fairly constant, points of distinction between these two species are as follows: *Æcidium ranunculacearum*: æcidia always in spots, preceded or accompanied by the spermogonia which are aggregated usually in the center of the æcidium spots. *Æcidium ranunculi*, Schweinitz: æcidia always effused, preceded or accompanied by the spermogonia, which are also effused and scattered, like the æcidia, indiscriminately over the surface of the leaf. Sometimes the leaf is thickly covered by the fungus and again it may bear only a cup here and there. The form of *Æcidium ranunculacearum* on *Ranunculus Cymbalaria*, so common at the West, at times shows some inclination to approach *Æcidium ranunculi* in its manner of growth, but after all never seems to lose entirely its specific characters.

ÆCIDIUM ALBUM, Clinton, in 26th Report of the New York State Museum for 1874 and *Æcidium porosum*, Peck, in Botanical Gazette, page 34, 1878, are identical. The two supposed species occur on the same host plants, and have constantly the same manner of growth from New York State to the Pacific Ocean. Herewith is given an amended description of this species: Spots none, cups few and scattered and almost superficial, or much crowded, in which case they appear to be deep-seated and give a porous appearance to the leaf surface; occupying a part or the whole of the lower surface of the leaves; frequently appearing on the stems also, in which situation they are hemispherical, or short-cylindrical, erumpent, and opening by a small, irregular, or roundish orifice. Spores from a bright orange color to almost colorless, very variable in this respect, subangular or roundish, oblong, oval or ovate, according to the free or crowded condition of the cups, 18 μ to 26 μ diameter. Saccardo in Sylloge, vol. 4, p. 787, says that *P. porosum* is distinct from *P. album*, but this can not be so.

ÆCIDIUM HELIOTROPI, Tracy and Galloway, is the same as *Æcidium biforme*, Peck, which was published first and therefore has precedence.

ÆCIDIUM PALMERI, n. s.

On *Pentstemon virgatus.* Willow Spring, Ariz., June, 1890, collected by Dr. Edward Palmer. Com. Dr. J. N. Rose.

Spots more or less elongated, but little paler than rest of leaf; a little or not at all thickened. Pseudoperidia not deep seated, amphigenous; usually numerous and closely set, but not crowded together; when first bursting the epidermis, ovate and nearly white, or with the faintest possible purple tinge; soon becoming cylindric-clavate, with rounded or ovate apex; twice to at least four times as high as broad, straight or slightly curved; becoming flesh-colored fading to white above and at last becoming reddish-orange and sometimes opening by a small central orifice in the rounded apex, but more frequently opening by the fragile, white, broadly and irregularly ovate, to deeply cleft, acute, erect marginal lobes, which latterly fall away, often irregularly, exposing to view the orange-colored spores which fill the tubes. Spores roundish or irregularly polygonal to ovate or oblong and variously compressed; smooth, or very minutely roughened, epispore thickish; spore contents granular, with numerous yellow oil globules which escape freely under pressure; usually there are also two or three deep yellow and variously shaped nuclei. Spores orange colored, $16-26 \times 16-23\ \mu$.

This well marked Æcidium is very distinct from *Æcidium pentstemonis*, Schwein.

PUCCINIA CLADOPHILA, Peck, on *Stephanomeria minor*, in Botanical Gazette February, 1879, page 127, is the same as *Puccinia Harknessii*, Vize, on *Lygodesmia*, in Grevillia, vol. 7, page 11, September, 1878. The latter has been referred to *Puccinia hieracii*, (Schum.) Mart., (P. Dietel in Hedwigia, 1889, page 181); therefore *Puccinia cladophila* must also be referred to *Puccinia hieracii*, as that species is now understood.

PUCCINIA MINUSSENSIS, de Thümen, No. 1430 of de Thümen's Mycotheca Universalis, is, like the preceding, *Puccinia hieracii*, (Schum.) Mart., and is very near the form on *Troximon glaucum* and the same as the form on *Lactuca pulchella* (syn. *Mulgedium pulchellum*), which is an American species nearly related to *Mulgedium Siberica*—the host of de Thümen's present species.

In Saccardo Sylloge, vol. 7, this *Puccinia* is left in specific rank, but the note after the description refers to its connection with *P. hieracii.*

PUCCINIA BIGELOVIÆ, Ellis and Everhart, in N. A. F., No. 2248, has accidentally been named after a wrong host genus. The specimens distributed in North American Fungi are on *Gutierrezia euthamiæ.* The genus *Gutierrezia* is related to *Bigelovia* and it is likely that the fungus will yet be found on hosts in the latter genus, for which reason the authors of the species prefer to let the specific name go unchanged.

Western mycologists would do well, however, to make a series of cultures with the spores of *Puccinia bigeloviæ*, *Puccinia variolans*, Harkness and of *Puccinia variolans*, *var. caulicola*, Ellis and Everhart, to see

whether or no these are really distinct. At the same time cultures should be made with the spores of *Puccinia tanaceti*, DC.,* to which they seem to be too closely related, to see again whether they are distinct from that species, for, after a careful study of a large and varied supply of material and the accurate sketching of spores of each form, their validity is left much in doubt. Properly conducted cultures alone can positively decide the question.

PUCCINIA ELLISIANA, Thüm., in Bulletin of the Torrey Botanical Club, Vol. VI, p. 215, is now regarded by Mr. Ellis, Professor Farlow, and others to be the same as *Puccinia andropogonis*, Schweinitz, which has the right of priority.

PUCCINIA WINDSORIÆ, Schw., VAR AUSTRALIS, n. var. (*Puccinia Dochmia B. and C.*, North Pacific Expl. Exped., No. 131, and *Puccinia Palmeri*, Scribner in herb.) On grass leaves, apparently *Muhlenbergia*, Nicaragua, Central America; C. Wright coll. No. 131, N. P. Expedition; also on *Muhlenbergia* sp., Mexico; collected by Dr. Ed. Palmer, 1886.

Hypogenous or sparingly amphigenous. Sori small, rather more pulvinate than in the species, owing to the long spore pedicels, irregularly disposed, linear or oblong, more or less confluent, but rarely so in straight lines, the ruptured epidermis scarcely or not at all evident. Uredospores subglobose, obovate to oblong-ovate, brown, tegument somewhat thickened; epispore more or less distinctly echinulate, 16–25 by 20–26; teleutospores obovate, broadly elliptical to subglobose, the two last forms predominating; from pale to deep chestnut brown, usually darkest at the thickened vertex; little or not at all constricted at the septum, obtusely rounded or occasionally bluntly apiculate, 16–30 by 23–36 μ; pedicel pale brown to subhyaline, 75–125 μ long, by 3 to 6 μ thick at the base of the spore. Differs from the species in the very marked preponderance of the subglobose form of teleutospores and in the very long slender pedicels. A form almost the same as this occurs in the District of Columbia and in Florida. This form again is linked to the various forms of the species as they occur in different northern States. The description of the species itself should be a little more modified in order to embrace the usual, but not the glaring variations. It is also to be noted that in the variety as well as in the species the spores are often more or less obliquely to vertiseptate and the pedicels often to all appearances come from the side instead of from the base of the teleutospore.

In Saccardo's Sylloge, Vol. VII p. 770, are given brief descriptions of *Triphragmium clavellosum*, Berk., and *Triphragmium Thwaitesii*, B. & Br. The former occurs in America on *Aralia nudicaulis*, and is said (l. c.) to occur also in Ceylon on *Paratropa terebinthinacea*, *Hedera* and *Amygdaleæ* species. The latter is given for Ceylon as occurring on *Hedera Vahlii*, and the question is asked whether it is not the same as

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*A careful study should also be made of *Puccinia tanaceti* DC. var. *Actinellæ* Webber on *Actinella acaulis*. If this is a good variety, then perhaps some others now included in the species, should be regarded in the same light. Anders.

T. clavellosum. I have not been able to secure Ceylon specimens referred to *T. clavellosum*, but it is quite likely that all such are referable to *T. Thwaitesii.* Of this latter I have secured an authentic specimen from Mr. J. B. Ellis, to whom it was sent by Dr. M. C. Cooke, of London, England. As *T. clavellosum* and *T. Thwaitesii* are related species it is easy to understand why confusion should arise concerning them, especially when we consider the meager published description in which spore measurements are entirely omitted. *T. Thwaitesii* is a quite distinct species from North American forms of *T. clavellosum*, and it is pretty safe to say that *T. clavellosum* is American and that *T. Thwaitesii* is Asiatic. I have, in the following, drawn up full descriptions of the two species. For the description of *T. clavellosum* I selected No. 844 of De Thümen's Mycotheca Universalis on *Aralia nudicaulis*, collected in the Adirondack Mountains, New York, by Ch. H. Peck. For the description of *T. Thwaitesii* I used the small specimen sent me by Mr. Ellis.

TRIPHRAGMIUM CLAVELLOSUM, Berk.

Epiphyllous; sori small, roundish-orbicular, or elliptical, surrounded by the ruptured epidermis and distinct, or as often confluent into apparently one large sorus, a quarter of an inch across, growing on more or less well defined spots. Uredospores not seen; teleutospores 30–40μ long by 16–30μ wide, globose to obovate or oblong in outline, the margin frequently not at all lobed, dark brown to almost black, epispore thickened and with numerous stout somewhat tapering appendages, the tips of which are emarginate, bifurcate, or even quadrate with four hyaline recurved lobes; pedicel at least as long as the spore, usually longer, 40–100 by 5–10μ thick at junction with base of spore, average size about 50μ long by 6μ thick, not much tapering and somewhat roughened. On *Aralia nudicaulis.*

TRIPHRAGMIUM THWAITESII, B. & Br.

Amphigenous, but most abundant on the upper surface of leaf; sori small, roundish, rarely confluent, growing on well defined irregular patches, which are blackish above and paler below. Uredospores (?) 28–35 by 30–50μ, oval to obovate, rather dark yellowish brown, epispore thickly beset with sharp awl-shaped spines about 3μ long; pedicel about length of spore, hyaline; teleutospores 30–60μ long by 27–59μ wide, globose to obovate outlined, more or less perfectly and uniformly three-lobed, often truncate at the apex, light brown to dark chestnut brown; epispore rather thick, appendages few, straight and tapering, expanding at the end into an emarginate and often distinctly bifurcated tip; pedicel about the length of the spore, seldom longer, slightly roughened, tapering to the slender and usually curved point, about 5μ thick at junction with base of the spore. It is possible that the uredospores described in the foregoing may belong to something else, as I only found two spores and they were mixed in with teleutospores. On *Hedera*, (?) Ceylon.

UROMYCES AMYGDALI, credited to Cooke in report on Insect and Fungous Pests, No. 1, by Henry Tryon, issued by the Department of Agriculture, Queensland, Australia, is doubtless *Uromyces amygdali*, Passer.; see the above report, page 97, Leaf Rust and Shedding of Foliage (*Uromyces amygdali*). At any rate this "*Uromyces*" turns out to be the uredo of *Puccinia pruni*, Pers. (See also Sacc. Syll. vol. VII, p. 648.) A series of excellent specimens has been received by the Division of Vegetable Pathology from two points in South Australia, collected on peach, plum, apricot, and almond leaves by Mr. F. S. Crawford and Mr. R. H. Simons. In some of these specimens the teleutospores have developed, and are present in great numbers in the same sori with the uredospores. They agree in every particular with specimens of *Puccinia pruni*, Pers. on peach and plum hosts in the United States.

UROMYCES SOPHORÆ, Peck, in Bulletin Torrey Bot. Club, Vol. XII, No. 4, p. 35, and *Uromyces hyalinus*, Peck, in Bot. Gaz. 1878, p. 34, are identical, and both again referable to the widely dispersed and consequently somewhat variable *Uromyces trifolii*, (Hedew.) Léveillé.

ENTYLOMA CRASTOPHILUM, Sacc., and ENTYLOMA IRREGULARIS, Johanson, are the same species, judging from the two specimens in the Herbarium of the Division of Vegetable Pathology—Krieger, Fungi Saxonici, 202; *Entyloma crastophilum*, Sacc. (Michelia I, p. 540, September 15, 1879), on *Agrostis?* W. Krieger leg; and Eriksson, Fungi Parasitici Scandinavici 259; *Entyloma irregularis*, Johanson, on *Poa annua*, C. J. Johanson coll. In the former specimen the spores are more angular than in the latter; the color is almost the same and the measurements of both are the same. As I make them, the measurements are 6–10 by 8–20μ, but rarely over 16μ long.

Saccardo's description was published first, hence *Entyloma crastophilum*, Sacc, has precedence.

USTILAGO SUCCISÆ, Magnus, *U. scabiosæ*, (Somer.) Wint. and *U. intermedia*, Schroeter, as given in Saccardo's Sylloge, vol. VII, p. 475 and 476, appear to be one species. They all occur in the anthers of *Scabiosa columbariæ* and *Scabiosa arvensis:* the name, *Knautia arvensis*, given in the Sylloge, is simply the old name of *Scabiosa arvensis. Ustilago intermedia* only differs from the other forms in its darker and more evidently reticulated spores, and does not seem to be more than a variety of *U. scabiosæ*, to which the other forms should be referred, and it is doubtful whether it deserves even varietal rank.

The notes now following were made directly from Berkeley & Curtis's type specimens in the Herbarium of the U. S. North Pacific Exploring Expedition under Commanders Ringgold and Rogers, 1853–'56. C. Wright collected the specimens.

PUCCINIA KAMTSCHATKÆ, Anders., n. s. On *Rosa* species, collected by C. Wright at Petropaulovski, Kamtschatka. Description

drawn up from specimen in the herbarium of the United States North Pacific Exploring Expedition under Commanders Ringgold and Rogers, 1853–'56. Specimens labeled "*Coleosporium pingue*, Lév. ?"

Amphigenous, but most abundant on lower surface of leaf where the sori are confluent and irregularly effused; on the upper surface the sori are usually small, fewer, and less often confluent; surrounded more or less perfectly by the much lacerated and conspicuous epidermis: in the effused patches irregular lines of this epidermis stick up here and there, marking more or less plainly the boundary of several or many irregularly confluent sori. Sori rather large, variable in outline, not definitely arranged, becoming pulverulent; light snuff-colored. Uredospores globose, short ovate, obovate to oblong elliptical, smooth or slightly roughened, pale yellowish brown to light brown; epispore one-half to almost 3μ thick, but little or not at all thickened at the vertex, 13–27 by $13–30\mu$. Teleutospores oblong, ovate, oval to broadly elliptical, segments generally divided equally, usually not much constricted at the septum; vertex broadly rounded or occasionally narrowed, but not apiculate; epispore as thick as that of the uredospores, smooth or somewhat roughened, frequently a little thickened at the vertex, light brown, 13–37 by $20–54\mu$; pedicel stout, but fugaceous, yellowish hyaline, once to twice the length of the spore; paraphyses intermixed with the spores, pedicel-like, cylindrical, a little or not at all swollen at the rounded apex.

The general appearance of this Puccinia *en masse* is that of the uredo stage of *Phragmidium subcorticum*, (Schrank). It thickens and changes the shape of the leaf just as that does, and without a microscopic examination would be passed over as *Phragmidium subcorticum II*, turned snuff brown. *Coleosporium pingue*, Léveillé, is merely the uredo of *Phragmidium subcorticum.* It is more than likely that *Puccinia Kamtschatkæ* will be found by careful seekers on various *Rosa* forms in the northern Rocky Mountains and along the northwestern coast of America.

PUCCINIA TRIARTICULATA, B. & C. Herbarium of the North Pacific Exploring Expedition, No. 130. Collected by C. Wright on *Elymus mollis*, Arakamtchetchene Island, Behring Straits. The original description is not complete, lacking spore measurements and other notes of value. We may expect to find this species in Alaska and along the northwestern coast of America generally. The following more complete description has been drawn up from a type specimen: Sori linear to narrowly oblong, buried in the tissue, but forming a pustule on the surface of the host, finally bursting the epidermis and presenting a level dark-brown surface. Uredospores ? Teleutospores two to three septate, 60–100 by $12–24\mu$; pale brown, elongated, oblong, narrowly cuneate or cylindric-clavate, with an ovate, or rounded, or more or less obliquely truncate apex, constricted at the septa or not; epispore thin, smooth, vertex frequently thickened; pedicel short, stout rather dark reddish brown,

strongly contrasting with the pale color of the spore, 5–9 by 5–14μ, and rather firmly attached to the dense parenchymatous stroma, which, like the pedicel, is reddish brown. This peculiar species is rather a doubtful Puccinia.

PUCCINIA SEPULTA, B. & C. Herbarium North Pacific Expedition, No. 131, on leaves of *Ficus?* Nicaragua, Central America. C. Wright, collector.

Hypophyllous, spots orbicular, brown on both sides, but more definitely outlined on the upper; bullate above, concave beneath; sori congested in a uniform mass and more or less perfectly covered by the host hairs adherent to the epidermal fragments protruding from between the crowded sori. Uredospores? Teleutospores 23–75 by 13–27, brown and smooth, extremely variable in size and shape, narrowly oblong and much elongated, or broadly clavate, obtusely elliptical, obovate, cuneate to broadly subturbinate; constricted at the septum, or not; apex subtruncate, or variously rounded, sometimes narrowed, usually thickened, lower segment quite often narrow and distinguishable only from the broad and often somewhat swollen pedicel by the septum at base, where it is often constricted; pedicel narrow or broad, frequently swollen above, but constricted at junction with the spore, less than twice the length of the spore, brown, or dilute brown, often coming from one corner of spore base instead of the center. Occasionally three-celled spores are seen, and even two perfectly formed spores normal in size are found, the base of the upper joined closely to the apex of the lower by about the width usually occupied by the pedicel; or, two spores may be joined laterally by a small surface of the upper segments, the lateral spore having no pedicel of its own, and again, the upper segment also of an individual spore is sometimes vertically septate, showing an inclination towards *Triphragmium*.

UREDO BAUHINIÆ, B. & C. Fungi North Pacific Expedition, No 138. C. Wright, coll., on *Bauhinia* sp.

Amphigenous, but more sparing above. Spots small, yellowish, or quite obsolete. Sori small, roundish, or orbicular, scattered, rarely confluent, dark reddish brown, the ruptured epidermis more or less evident; spores globose, broadly obovate or broadly and obtusely elliptical, echinulate, reddish fuscous, 26–30 by 26–33μ, epispore 3–5μ thick; pedicel 20–30μ long, hyaline and fragile.

INDEX TO NORTH AMERICAN MYCOLOGICAL LITERATURE.

By David G. Fairchild.

113. Arthur, J. C. **Treatment for smut in wheat.** Bull. 32, Vol. II, July, 1890, pp. 1-10, Indiana Agr. Exp. Sta., La Fayette, Ind. Gives tests of vitality of seed wheat after treatment with Jensen hot-water method for smut. Finds 66° C. as maximum temperature at which the vitality of the seeds is retained and immersion for five minutes in water at a temperature of 57° C. to give the largest percentage of uninjured grains, considering high temperature. Recommends lengthening time of immersion with lowering of temperature and vice versa. No test of the method as to preventive power against smut. Gives percentages of stalks smutted with loose smut in counts of two varieties as 11.58 per cent. and 24.41 per cent.
114. ——— and Bolley, H. L. **The specific germ of the carnation disease.** Bot. Gaz., September, 1890, Vol. XV, No. 9, p. 231 Abstract of paper read by title before A. A. A. S. Botanical Section, August 19, 1890. Indicates demonstration of bacterial disease.
115. Atkinson, Geo. F. **A new Ramularia on cotton** (with figures). Bot. Gaz., Vol. XV., No. 7, July 22, 1890, p. 166. Describes and figures as new, *Ramularia areola*, n. s. on cotton, which differs from *R. serotina* and *R. virgaureæ* in having stouter conidia and hyphæ.
116. Bailey, L. H. **Report on the condition of fruit-growing in western New York.** Bull XIX, August, 1890, Cornell Agr. Exp. Sta., Ithaca, N. Y., pp. 45–58 (with figs) Notices as particularly abundant in 1890: *Fusicladium dendriticum*, (Wallr.) Fckl. on apples; *F. pyrinum*, (Lib.) Fckl. on pears. Quince and pear leaf blight, *Entomosporium maculatum*, Lév. *Taphrina deformans*, *Glœosporium venetum* or *G. necator*, *Sphærella fragariæ*, Sacc. and various grape diseases. Gives latest ideas in treatment of various maladies.
117. Beadle, D. W. **The apple scab.** Horticultural Art Journal, Rochester, N. Y. October, 1890, Vol. V, part 10, p. 82. Sums up work of L. R. Taft in Mich., Agr. Exp. Sta. in 1889 (*see* 104).
118. Bessey, Chas. E. **The completion of Saccardo's Sylloge Fungorum.** American Naturalist, July, 1890, XXIV, 283, p. 675. Reviews and commends the work, giving synopsis of orders with total numbers of species described, 31,927 in all.
119. Bolley, H. L. **Potato scab, a bacterial disease.** Bot. Gaz., September, 1890, Vol. XV, No. 9, p. 234. Abstract of paper read before A. A. A. S. Botanical Club, August 19, 1890. Gives histology and biology of disease, with outline of infection experiments performed.
120. ———. **Potato scab, a bacterial disease.** Agricultural Science, La Fayette, Ind., September 1890. Vol. IV, No. 9, pp. 243–256. Discusses at some length the theories regarding the nature and cause of the disease, viz., mechanical irritation, insect agencies, chemical erosion, excess of moisture, action of fungi. Follows with a record of original investigation, noting work of Dr. Brunchorst, of Sweden, who describes *Spongospora solani* as cause of the malady. Records results of various infection tests, inoculating young tubers in various ways with various species of bacteria found present in the diseased areas. Gives conclusive experiments to determine that disease is transmitted by the practice of planting scabby seed potatoes.
121. ——— *Ibid.* Oct. No. 10. pp. 277–287. Continues description by treating of separation and culture methods; infection or inoculation of growing tubers; characteristics of development upon artificial culture media; drop cultures; stick cultures; streak cultures; cultures on sliced cooked potatoes; effect of

121. BOLLEY, H. L.—Continued.
gases and of different degrees of temperature upon the development of the bacterium; name of bacterium, relation to the host, mode of attack. Gives plates III and IV with bibliography of disease.

122. BRITTON, N. L., AND HOLLICK, ARTHUR. **List of Staten Island fungi in the collection of the Association.** Proc. Nat. Sci. Ass. of Staten Island. Special, No. 11, August 1890. *Basidiomycetes* 37, *Ascomycetes* 3, *Hypomycetes* 1. *Myxomycetes* 1. Determinations by J. B. Ellis.

123. CHESTER, F. D. **Diseases of the vine.** Bull. X, Delaware State Agricultural Exp. Sta., Newark, Del. 1890, pp. 8–32. Gives results of experiments at Smyrna with black-rot. Used Bordeaux mixture and saved 99.5 per cent. fruit in comparison with 84 per cent. unsprayed. Records use of ammoniated copper carbonate, copper carbonate and ammonium carbonate mixture, precipitated copper carbonate, and Bordeaux mixture against anthracnose, deciding the precipitated copper carbonate and Bordeaux mixtures as wholly effectual. Reports use of above copper mixtures with modified eau celeste and mixture No. 5, U. S. Dept. of Agr. against black-rot near Newark, also of study, by periodical bagging, of progress of disease in vineyards. Gives directions for preparing fungicides, prices of chemicals, and recommendations as to spraying apparatus.

124. ELLIS, J. B., AND EVERHART, B. M. **New North American Fungi.** Reprint from proceedings of Academy of Natural Sciences of Philadelphia, July 29, 1890. Describes as new 100 species, mostly saprophytic, as follows: *Typhula subfasciculata, Stereum atrorubrum, Hymenochæte rugispora, Asterina rubicola, A. bignoniæ, Chaetomium pusillum, Myriococcum consimile, Calosphæria alnicola, C. microsperma, Cœlosphæria corticata, Diaporthe nivosa*, Ell. & Holw., *Valsa floriformis, V. glandulosa*, Cke., *V.* (*Eutypella*) *canodisca*, Ell. & Holw., *Pseudovalsa stylospora, Thyridaria fraxini, Cryptovalsa sparsa, Diatrype Macounii, D. Hochelagæ, Diatrypella vitis, D. Demetrionis, Ceratostomella mali, Ceratostoma juniperinum, C. parasiticum, C. conicum, Rosellinia albolanata, R. glandiformis, R. parasitica, R. Kellermanni, R. Langloisii, Anthostoma Ontariensis, Anthostomella ludoviciana*, Ell. & Lang., *Hypoxylon albocinctum, Poronia leporina, Physalospora zeicola, P. conica, P. pandani, Læstadia orientalis, L. apocyni, Sphærella conigena**, *S. spinicola, S. ciliata, S. angelicæ, S. macluræ, S. polifolia, Didymella Canadensis, D. cornuta, D. andropogonis, D. mali, Venturia parasitica, V. sabalicola, Diaporthe Columbiensis, D.* (*Euporthe*) *leucosarca, D. coringera, D. comptoniæ, D. Americana*, Speg., *D. megalospora, Didymosphæria andropogonis*, E. & Lang., *Melanconis salicina, Valsaria salicina, Leptosphæria macluræ, L. steironematis, L. brunellæ, L. folliculata, Metasphæria rubida, Pleospora diaportheoides, P. hyalospora, Pyrenophora Zabriskieana, Fenestella amorpha, Ophiobolus trichisporus, O. medusæ, Melanomma Commonsii, M. tetonensis, M. parasiticum, Winteria tuberculifera, Cucurbitaria Kelseyi, C. fraxini, C. setosa, Teichospora mammoides, T. mycogena, T. umbonata, T. papillosa, T. megastega, T. Helenæ, T. Kansensis, Nectria diplocarpa, Hypocrea pallida, H. melaleuca, Calonectria Dearnessii, Thyronectria chrysogramma, Chilonectria cringera, Nectria sambuci, N. athroa, N. mammoidea*, Phil. & Plow., *N. pithoides, N. sulphurata, Homostegia Kelseyi, Dothidea bigeloviæ, Plowrightia staphylina, P. symphoricarpi, Curreya shepherdiæ.*

125. FAIRMAN, C. E. **Contributions to the mycology of western New York.** I. The fungi of western New York. Extract, Proc. Rochester Academy of Sciences, Vol. I, August, 1890, pp. 43–53, with plates 3 and 4. Notes the discovery in Orleans County of 425 species variously distributed among the different orders, with remarks on more common species. Remarks: *Septoria stellariæ*, R. & D., on

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* This is changed to *S. Andersoni*, as there is already an *S. conigena*, Pk.

125. FAIRMAN, C. E.—Continued.
Stellaria media. *Phyllosticta cirsii*, Desm., on *Cnicus arvensis*, *Corticium liridocæruleum*, Karst., *Tapesia rosæ* (Pers.) as new to this country. Appends list of 30 species or varieties, 17 of which are new. Those described as new are as follows: *Didymosphæria accedens*, Sacc. (with fig.) *Anthostomella eructans*, E. & E. (with fig.) *Lophiostoma rhopaloides*, Sacc. var *pluriseptata*, n. var., *Pseudovalsa Fairmani*, E. & E., *Vermicularia solanoica* n. s. on *Solanum dulcamara*, *Phoma Weldiana* n. s. on *Euonymus atropurpureus*, *Phoma alborestita*, n. s., *Phoma Lyndonvillensis*, n. s. on *Malva rotundifolia*, (with fig.) *Phoma rudbeckiæ*, n. s. on *Rudbeckia laciniata*, *Diplodia maura*, C. & E., var. *Americana*, Ell. on *Gyrus americana*, *Morthiera Thuemenii*, Cooke, var. *Sphærocysta* Pk. on *Crategus*, *Sphæropsis lappæ*, E. & E. on *Lappa major*, *Sporidesmium toruloides*, E. & E. on *Cornus*, *Mucor tæniæ*, n. s. on *Tænia solium* (with fig.) *Helotium fumosum*, E. & E. on *Leonurus cardiaca* and *Lappa major*, *Camarosporium acerinum*, E. &. E. on *Acer* limbs, *Tubulina cylindrica*, Bull., var. *acuta*, Peck.

126. FARLOW, W. G., AND SEYMOUR, A. B. **A provisional host index of the fungi of the United States, Part II. Gamopetalæ-Apetalæ**, Cambridge, Mass., September, 1890; pp. 53-133–Quarto. Part I, issued in 1888. Gives in most convenient form index of all published host plants, together with partial synonymy of different species of fungi. Myxomycetes are omitted from the list except when of more than usual interest. In cases of very common fungi occurring on many species of host plants the authors do not include all hosts, unless the fungus is of economic importance.

127. FORSTER, EDWARD J. **The Study of mushrooms.** Boston Medical and Surgical Journal, October 2, 1890. Reprinted leaflet. Gives, in reply to inquiries, a list of 14 works upon *Hymenomycetes* with special reference to esculent species. No reference made to periodical literature.

128. ———. **Mushrooms and mushroom poisoning.** Read at Ann. Meeting Mass. Med. Soc., June 11, 1890, Boston City Hospital. Pamphlet. Distinguishes, precisely, edible and poisonous forms (with figures), giving minute instructions as to habitats; adds a table of statistics of 44 cases of mushroom poisoning; concludes all known fatal cases caused by eating *Amanitæ;* gives as universal antidote atropia in full doses, $\frac{1}{8}$ of a grain, preceded by usual emetics and purgatives.

129. GALLOWAY, B. T. **New fields, the past and the future in the world of fungi.** American Garden, September 24, 1890; pp. 573-577. Times Building, New York. Gives in popular language a short history of Economic Mycology, with account of the extension in this country of the use of fungicides and fungicidal apparatus. Figures examples of treated and untreated plants, together with a new knapsack pump.

130. ———. **Some recent observations on black-rot of the grape.** Botanical Gazette, October 28, 1890, Vol. XV, No. 10, pp. 255–259. Records series of four experiments to establish connection of *Phyllosticta labruscæ*, Thüm., *P. ampelopsidis*, E. & M., and *Læstadia Bidwellii*, (Ell.) V. & R. States results of 200 inoculations of grape berries with leaf pycnidiospores and 200 inoculations of leaves with berry pycnidiospores as purely negative. Fifty inoculations of berries with berry pycnidiospores also produced no result; but both inoculations of *Ampelopsis* and *Vitis* leaves with ascospores from berries produced characteristic spots and pycnidia. Gives account of methods employed.

131. ———. **Preliminary notes on a new and destructive oat disease.** Botanical Gazette, September, 1890, Vol. XV, No. 9, p. 228. Abstract of paper read before Botanical Section A. A. A. S., August 19, 1890. Notes discovery of cause of the disease as a micro-organism, grown in various cultures.

132. ———. **Observations on the life-history of Uncinula spiralis.** *Ibid.* Abstract of paper given before Botanical Section A. A. A. S. Gives life-history and methods used to establish relationship between various forms.

133. GOLDEN, KATHERINE E. **Fermentation of bread.** Botanical Gazette, August 25, 1890, Vol. XV, No. 8, p. 204. Gives summary of previous work on the subject, with original investigation with plate culture methods. Finds in case examined *Saccharomyces cerevisiæ* and *Bacillus subtilis* (?) present in yeast, proving both to be able to raise bread sponges. Concludes yeast to be more effective in the production of gas in the sponges and Bacteria in the fluid cultures. Decides both to work together in producing the bread fermentation.

134. HALSTED, B. D. **Peronospora rubi, Rabenh., in America.** Botanical Gazette, Vol. XV, No. 7, July 22, 1890, p. 179. Notices first appearance of the fungus on cultivated raspberry in this country.

135. ———. **Some fungous diseases of the spinach.** Bull. 70, July 26, 1890. New Jersey Agr'l College Expt. Sta., New Brunswick, N. J., pp. 15 (with 21 figs.). Gives popularized descriptions with figures of *Peronospora effusa*, Rabenh., *Colletotrichium spinaceæ*, Ell. & Hals., *Phyllosticta chenopodii*, Sacc., *Entyloma Ellisii*, Hals., *Cladosporium macrocarpum*, Drew. Points out difficulty of treatment for diseases on account of nature of use to which spinach is put and recommends clean culture, destruction of weed host plants, and cautious use of chemical fungicides, also mixture of lime and sulphur with soil.

136. ———. **A dangerous enemy to the radish.** Garden and Forest, November 5, 1890, Vol. III, No. 141, p. 541. New York City. Notes great injury to crop by a species of *Plasmodiophora*, thought to be identical or nearly related to that causing club-root of cabbage.

137. ———. **The rot among late potatoes.** Garden and Forest, November 12, 1890. No. 142, Vol. III, p. 551. Shows danger from *P. infestans* in late planting of potato

138. ———. **Effect of forest management on orchards.** Garden and Forest, October 8, 1890, Vol. III, No. 137, p. 487. Discusses injurious proximity of cedar trees bearing the fungus *Gymnosporangium*, citing marked case of injury. Notes black-knot of plum and blackberry rust in connection.

139. ———. **The egg-plant blight.** Garden and Forest, September 17, 1890, Vol. III, No. 134, p. 457. Notes destructive occurrence of *Phyllosticta hortorum*, Speg. upon leaves and fruit of egg-plant. Remarks its especially destructive nature in Gloucester County, N. J. Thinks it can be checked by the copper mixtures.

140. ———. **The celery blight.** Garden and Forest, October 1, 1890, Vol. III, No. 136, p. 141. Notes destructive abundance of *Cercospora apii* in Mercer County, N. J., its habit of thriving in dry weather; suggests use of ammoniacal copper carbonate and shading with lath as remedies.

141. ———. **Cedar galls and rust on apple leaves.** Cult. and Country Gentleman, Albany, N. Y., October 2, 1890, Vol. LV, No. 1966, p. 780. Notes destructive abundance of apple rust (*Ræstelia*) in orchards in Mercer County, N. J. Explained by proximity of cedar trees affected by cedar galls (*Gymnosporangium*).

142. ———. **Sweet potato rot in New Jersey.** The soil rot. Cult. and Country Gentleman, October 9, 1890, p. 796, Vol. LV, No. 1967. Describes the fungus as living in the soil from year to year and records cases of spread from diseased fields to healthy ones.

143. ———. **Smut in grain.** Cult. and Country Gentleman, Albany, N. Y., March 6, 1890, Vol. LV, No. 1936, p. 184. Gives description of Jensen's hot-water treatment in prevention, referring to work in Kansas by Kellerman and Swingle (see No. 156).

144. ———. **Sundry sweet potato rots.** Cult. and Country Gentleman, April 10, 1890, Vol. LV, No. 1941, p. 286. Notes five kinds of rot of sweet potatoes with suggestions as to treatment.

145. ———. **Canada thistle rusting out.** American Agriculturist, August, 1890, Vol. XLIX, No. 8, p. 402. Notes destruction of Canada thistle about New Brunswick, N. J., through the attacks of the rust (*Puccinia suaveolens*, (*Pers.*) *Wint.*).

146. HARKNESS, H. W. **Dangerous fungi.** Zoë, San Francisco, Cal., July, 1890, Vol. I, No. 5, p. 150. Gives localities in California where *Peronospora viticola*, *Plowrightia morbosa*, *Taphrina* (*Exoascus*) *pruni* are destructive. Notes freedom of *Prunus ilicifolia* from disease.

147. ———. **Fungi collected by T. S. Brandegee in Lower California.** Proc. Cal. Acad. Sci., Second Series, Vol. II, 1889, December 20, 1889 (distributed 1890). Names 14 species, describing as new, *Puccinia ornata*, Hark. with Plate XII on *Tacoma stans*, Commondu. Related to *P. medusæ*, Speg., differing in size.

148. HARVEY, F. L. **The potato rot** (*P. infestans*). Ann. Rep. Maine Ag. Exp. Sta., 1889 (1890), Bangor, Me., pp. 173, 181 (with plate by C. H. Fernald figuring so-called oospores). Gives origin, history, primary causes, secondary causes, conditions of growth, description, life-history, and remedies, direct and preventive.

149. ———. **Apple scab.** *Ibid.*, pp. 182, 184 (with plate copied from U. S. Dept. of Ag. Report, 1887). Reviews work done by Taft in Michigan and Goff in Wisconsin (see 42 and 104).

150. HICKMAN, J. F. **Smut in wheat.** Bull. Ohio Ag. Exp. Sta., Second Series, Vol. III, No. 6, July, 1890, p. 205. Reports unusual abundance of stinking smut, with table of percentages of smut estimated in field, and counts of the number of smutted grains in 1,000 grains after threshing, also result of use of too strong solution of copper sulphate.

151. HOWELL, MISS J. K. **Trimorphism in Uromyces trifolii.** Bot. Gaz., September, 1890, Vol. XV, No. 9, p. 228. Abstract of paper read before A. A. A. S. Botanical Section, August 19, 1890. Records cultures made to determine connection of the three forms. Finds æcidiospores germinating throughout the winter. Proves the relationship beyond question.

152. HUMPHREY, J. E. **Mildews.** Trans. Mass. Hort. Soc. 1889, Pt. I, 1890, Boston, Mass., pp. 40, 52. Gives statement of object of new department of vegetable physiology connected with station. Describes in clear popular language the growth, life-history, and means of combating the powdery mildews (*Peronosporaceæ*). Notes *Pythophthora infestans*, DBy., *Peronospora viticola*, B. & C., *P. gangliformis*, Tul., *P. graminicola*, Sacc. on Hungarian grass or millet, *P. Schleideniana*, Ung.

153 KEAN, A. L. **On the nature of certain plant diseases.** Bot. Gaz., Vol. XV, No. 7, July 22, 1890, p. 171. Notices peculiar habits of *Rhizopus nigricans* with reference to parasitism on sweet potatoes. Claims the discovery of an active "ferment," excreted by fungal hyphæ, which precedes the growth of the hyphæ, breaking down the tissue. Mentions alcoholic precipitate as poisonous to healthy tissue. Thinks such fungi not truly parasitic, but dependent upon chemical agents for their disease causing power. Refers to H. M. Ward's lily disease in Ann. Bot., May, 1889.

154. KELLERMAN, W. A. **Prevention of smut in cereals.** Agricultural Science, Vol. IV, No. 4, April, 1890, pp. 99-101. Lafayette, Ind., gives account of Jensen hot-water method of prevention with modification found necessary for barley, consisting in soaking the seed eight hours in cold water before plunging into hot water.

155. ———. **Prevention of stinking smut in wheat.** Industrialist, Manhattan, Kans., October 4, 1890, Vol. XVI, No. 3, p. 9. Reproduction of description of Jensen hot-water method to prevent smut contained in Bull. 12, Bot. Department, Kans., Ag. Coll. Exp. Sta., August, 1890 (see No. 157).

156. ——— AND SWINGLE, W. T. **Report on the loose smuts of cereals.** Report of Botanical Department. Extract from Annual Rep. Kans. State Ag. Exp. Sta., Manhattan, Kans., 1890, pp. 213-288, Plates I to IX. Gives most thorough treatment of the whole subject, including synonomy of loose smuts: splitting up the hitherto well-known *Ustilago segetum*, (Bull.) Ditm. or *Ustil-*

156. KELLERMAN, W. A., AND SWINGLE, W. T.—Continued
ago carbo, (DC.) Tul., indiscriminately called, into *Ustilago avenæ*, (Pers.) Jensen (oat smut); *Ustilago tritici*, (Pers.) Jensen, (loose smut of wheat); *Ustilago hordei*, (Pers.) Kellerman and Swingle (covered barley smut); *Ustilago nuda*, (Jensen) Kellerman and Swingle (naked barley smut); of *Ustilago avenæ* (Plates I, IV, V), gives history, synonomy, injuries to host plant, different varieties attacked, amount of damage (in general over 8 per cent., at Manhattan, Kans., 10 per cent.), geographical distribution, botanic and microscopic characters of the smut, germination of spores in water, germination of spores in nutrient solutions, infection of the host plant (historical), methods of treatment (mechanical, chemical, and physical, with description of Jensen's hot-water method and report of successful experiment with same): notes a new form of oat smut (*Ustilago avenæ* var. *levis*, Kell. and Swingle.) Of *Ustilago tritici*, (Pers.) Jensen (Plates II and VI), history, synonomy, injuries to host plant, geographical distribution, characters of the smut, germination of spores in water, germination of spores in nutrient solutions, prevention. Of *Ustilago hordei*, (Pers.) Kell. and Swing. (Plates II and VII), gives history, synonomy, nature of injuries to host plant, geographical distribution, characters of the smut, germination in water, germination in nutrient solution, manner of infection of host plant, methods of prevention. Of *Ustilago nuda*, (Jensen) Kell. and Swing., gives history, synonomy, injuries to host plant, geographical distribution, botanical and microscopic characters of the smut, germination of spores in water, germination of spores in nutrient solution, manner of entering the host plant, methods of prevention. Natural enemies of the smut (Plate IX), *Fusarium ustilaginis*, Kell. and Swing. *Macrosporium utile*, Kell. and Swing., *Bacterium* (?) sp. Smut-eating beetles, *Phalacrus politus* or *penicillatus* and *Brachytarsus variegatus*, Say. Gives note also on stinking smut of wheat (Plate III), caused by *Tilletia fœtens*, (B. and C.) Trel. and *Tilletia tritici*, (Bjerk.) Wint.

157. ———. **Preliminary experiments with fungicides for stinking smut of wheat.** Bull. No. 12, August, 1890. Kansas State Agr. Exp. Sta., Manhattan, Kans., pp. 27–51 with Plate I. Give as introduction, amount of damage, cause of disease, growth of characters of parasite, germination of spores, comparison of loose and stinking smut, mode of infection. Report on use of 51 different treatments for disease, deciding Jensen hot-water method most successful (see p. 117 this number of the JOURNAL.)

158. LONG, E. A. **Plum-leaf blight or shot-hole fungus.** Pop. Gardening, Buffalo, N. Y., Vol. V, No. 12, p. 249, 1890. Notes *Septoria cerasina*, Pk. (with sketch). Recommends burning dead leaves, and spraying early in season with Bordeaux mixture.

159. MCMILLAN, CONWAY. **Note on a new species of Actinoceps, B. and Br.** American Naturalist, August, 1890. Vol. XXIV, No. 284, p. 777–779. Describes as new *Actinoceps Besseyi*, McM. found on putrid orange skin among bacteria, thinking difference in size of stipe and head sufficient to separate it from *Actinoceps Thwaitesii*, B. &. Br.

160. MEEHAN, THOMAS. **Fairy rings.** Cult. and Country Gentleman, Albany, N. Y., January 16, 1890, Vol. LV, No. 1929, p. 48. Gives history and description, referring cause to species of *Agaricini*, varying with different cases. Divides rings into two classes: one with dead grass in center, other with ring only.

161. PAMMELL, L. H. **Treatment of fungous diseases.** Orange Judd Farmer, Chicago, Ill., November 1, 1890, Vol. VIII, No. 18, p. 277, ½ column. Notices shortly history of growth of this line of mycology.

162. ———. **Pear-leaf blight.** Orange Judd Farmer, Chicago, Ill., October 25, 1890, p. 261, Vol. VIII, No. 17. Gives extended notice of work of U. S. Dept. of Agr. against *Entomosporium maculatum*, Lév. in season 1889–1890 (see No. 11).

163. ——. **Pear or fire blight.** Orange Judd Farmer, Chicago, Ill. Vol. VIII, No. 13, September 27, 1890, p. 197. Gives short history with observations and recommendations of treatment.

164. —— **Strawberry-leaf blight.** Orange Judd Farmer, Chicago, Ill., August 23, 1890, Vol. VIII, No. 8, p. 115 (with figures). Gives popular exposition of disease caused by *Sphærella fragariæ* Sacc., methods which have been used and recommended in its treatment.

165. —— **Strawberry-leaf blight.** Iowa State Register, Des Moines, Oct. 17, 1890, p. 7. Gives popular description with recommendations for treatment, viz, garden hygiene and fungicides, making reference to work of U. S. Dept. of Agr.

166. PANTON, J. HOYES. **Black-knot on plums.** Bull. LII., January 16, 1890. Guelph, Ontario. Describes the fungus popularly. Recommends destruction of diseased parts and removal of wild choke-cherry trees adjacent to orchards.

167. PECK, CHARLES H. **A. Plants added to the herbarium. C. Plants not before reported. D. Remarks and observations. E. New York species of Armillaria. F. Communication by P. H. Dudley in reference to decay of railroad ties.** Ann. Rep. State Botanist of New York, from 43 Rep. of N. Y. State Museum of Nat. History, Albany, N. Y., March 21, 1890; pp. 1–54, with 4 plates. Gives the usual list of additions to the herbarium, with notes on destructiveness of *Monilia fructigena*, *Glœosporium ribis*, *G. lagenarium*, *G. Lindemuthianum*, *Rhopalomyces cucurbitarum*, *Peronospora viticola*, *Phytophthora infestans* (with trials of Bordeaux and methods of deep planting to prevent the disease). Notes disease of oats in St. Lawrence County, thought to be due to *Fusicladium destruens*, n. s. and describes forty-two new species of fungi with numerous valuable notes upon old and new species, adding a short monograph of the eight known New York species of *Armillaria*. Appends interesting letter from P. H. Dudley upon fungi attacking railroad ties and other timbers. The species described as new are as follows: *Tricholoma grave* (with figs.), *Clitocybe multiceps*, *Coprinus brassicæ* (with figs.), *Cortinarius* (*Phlegmacium*) *glutinosus*, *C.* (*Inoloma*) *annulatus* (with figs.), *C.* (*Dermocybe*) *luteus*, *C.* (*Telamonia*) *paludosus*, *Lactarius subinsulsus*, *L. mutabilis* (with figs.), *Russula brevipes* (with figs.), *Marasmius albiceps* (with figs.), *Poria aurea*, *Irpex rimosus*, *Corticium mutatum*, *C. subaurantiacum*, *C. basale*, *Peniophora unicolor*, *Clavaria similis*, *Comatricha longa* (with figs.), *C. subcæspitosa* (with figs.), *Phyllosticta bicolor* on *Rubus odoratus*, *P. prini* on *Ilex verticillata*, *P. silenes* on *S. antirrhina*, *Phoma allantella* on *Quercus rubra*, *Plasmopara viburni* on *Viburnum dentatum*, *Sporotrichum cinereum*, *Coniosporium polytrichi*, *Stachybotrys elongata* (with figs.), *Dematium parasiticum*, *Fusicladium destruens* (with figs.) on *Avena sativa*, *Macrosporium polytrichi*, *Tubercularia carpogena*, *Fusarium sclerodermatis*, *Glœosporium leptospermum*, UNDERWOODIA gen. nov., *U. columnaris* (with figs.), *Helotium mycetophilum*, *Hæmatomyces faginea* (with figs.), *Eutypella longirostris* (with figs.), *Lepiota farinosa*, *Pholiota æruginosa*, *Phellorina Californica*.

168. PORTER, MISS E. **Notes on spore discharge of ascomycetes.** Bull. Torrey Bot. Club., New York, September, 1890, Vol. XVII, No. 9, p. 238. Abstract of paper read August 26, 1890, before Botanical Club of A. A. A. S., Indianapolis, Ind. Gives observations of this process in *Pleospora*.

169. REX. GEORGE A. **A remarkable variation of Stemonitis Bauerlinii, Mass.** Proc. Nat. Sci. Ass'n, Staten Island, No. 11, August, 1890. Notes curious case of reversion of an extremely variant form to the original Stemonitis type. Records the variation as *S. Bauerlinii* var. *fenestrata*, Rex.

170. RUSSELL, H. L. **Penicillium and corrosive sublimate.** Bot. Gaz., August 25, 1890. Vol. XV, No. 8, p. 211. Notes Dr. Coulter's remark in March number of Gazette, giving plate-culture tests with percentage solutions of mercuric chloride. Finds the fungus no more able to stand presence of germicide than other species, when the latter is thoroughly mixed in the media.

171. SCRIBNER, F. L. **Pear scab.** Orchard and Garden, Little Silver, N. J., August, 1890, Vol. XII, No. 8 (with figs.). Gives description of disease caused by *F. dendriticum*, (Wallr.) Fckl., considering the latter synonymous with *F. pyrinum*, (Lib.) Fckl. Shows necessity of early spraying. Recommends ammoniacal copper carbonate.

172. ——— **The powdery mildew of the rose.** Ibid, p. 144 (with figs.). Describes disease carefully, giving for remedies sulphur and potassium sulphide.

173. SOUTHWORTH, MISS E. A. **A new hollyhock disease.** Bull Torr. Bot. Club, Vol. XVII. No. 9, September, 1890, p. 235, N. Y. Notice of paper read by B. T. Galloway before Botanical Club A. A. A. S., Indianapolis, Ind., August, 1890. Describes diseases as caused by *Colletotrichium althææ*, n. s.

174. WEED, C. M. **The potato blight.** Am. Agriculturist, New York. Vol. XLIX, No. 7, p. 360. Notes successful attempts to control ravages of *Phytophthora infestans* with the Bordeaux mixture. Gives formulæ and method of treatment.

175. ———. **An experiment in preventing the injuries of potato rot.** Sci. Am., April 5, 1890, Vol. LXII, No. 14, N. Y., p. 217.

176. YEOMANS, W. H. **Bean rust and other fungous diseases.** Popular Gardening, Buffalo, N. Y., November, 1890, Vol. VI, No. 2, p. 27. Notes very destructive fungous diseases of bean leaves. Scientific name not given.

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF VEGETABLE PATHOLOGY.

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THE JOURNAL OF MYCOLOGY:

DEVOTED ESPECIALLY TO THE STUDY OF FUNGI IN THEIR RELATION TO PLANT DISEASES.

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THE CHIEF OF DIVISION AND HIS ASSISTANTS.

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EDITED BY

THE CHIEF OF DIVISION AND HIS ASSISTANTS.

CHIEF,
B. T. GALLOWAY.

ASSISTANTS,
EFFIE A. SOUTHWORTH. DAVID G. FAIRCHILD. ERWIN F. SMITH.

EXPERIMENTS IN THE TREATMENT OF PLANT DISEASES.

By B. T. GALLOWAY and D. G. FAIRCHILD.

PART II.

TREATMENT OF PEAR LEAF-BLIGHT AND SCAB IN THE ORCHARD.

Dr. W. S. Maxwell's orchard, where these experiments were conducted, is situated near Still Pond, Maryland, in a region known as the Eastern Shore. This region is justly celebrated for its abundant yields of fruit, pears in particular being one of the most profitable crops. Of late years, however, this fruit has suffered greatly from the attacks of two diseases commonly known as leaf-blight and scab. These maladies are not confined to the Eastern Shore. On the contrary, we find them causing more or less damage wherever the pear is grown, so that these remarks are in a measure applicable to the whole country.

The leaf-blight and scab are caused by two very different species of fungi, which have received the rather formidable names of *Entomosporium maculatum*, Lév., and *Fusicladium pirinum*, (Lib.) Fckl., respectively.

The Entomosporium has already been made the subject of some investigations by this Division,* but no work in the line of preventing the injuries of the Fusicladium have, previous to this year, been undertaken. Dr. Maxwell being a heavy loser every season from both the diseases, and having placed his extensive orchards at our disposal, it was decided to carry on the work at his place.

* Circular No. 8, 1889; Bulletin No. 11, 1889.

PEAR LEAF-BLIGHT.*

In the work on this disease an effort was made to throw some light upon the following questions:

I. The relative value, as preventives of the disease, of the Bordeaux mixture, the ammoniacal solution, mixture No. 5,† copper carbonate in suspension, and copper acetate.

II. The number of treatments necessary to obtain the best results at the least expense.

III. The relative value of early and late sprayings.

IV. Cost of each treatment.

The orchard chosen for the work consisted of Bartlett standards, Bartlett dwarfs and Duchess dwarfs, all of which were last year early defoliated by the leaf blight.

Following is a detailed account of the work taken from our field notes:

1. BORDEAUX MIXTURE.—*One treatment to two adjacent rows of 54 Bartlett standards.*—The treatment was made May 29, after the foliage was already partially diseased, numerous patches of the fungus being plainly visible on many of the leaves. Forty-four gallons of the mixture were used, costing 92 cents, or 1.7 cents per tree. The labor of preparing and applying was 60 cents, or 1.1 cent per tree, considerably less than in the experiments on a smaller scale.

Results.—The difference between the sprayed and unsprayed rows was very great, the latter appearing almost entirely bare on September 24, while the former were still in full leaf. Had the appliances at hand permitted the topmost branches to be sprayed thoroughly the difference would have been still more striking. It may be well to add here that for the entire work we used a Nixon Little Giant machine provided with 16 feet of hose and a Vermorel nozzle. Two men were required to work this apparatus, one to do the pumping and move the machine from tree to tree, the other to handle the nozzle. The machine did its work quickly and efficiently as is shown by the very small cost of the treatment.

The apparatus as it was used cost somewhere in the neighborhood of $40. We are satisfied, however, that a machine fully as efficient could be constructed by any intelligent person for less than half the above sum. Such a machine, made by us the past season and used in treating nursery stock, consists of a small force pump fastened to a barrel, the latter in turn being seated upon a sled which is drawn by a horse or mule. The machine, provided with 14 feet of hose and a Vermorel nozzle, can be made for about $18. This apparatus requires a horse, a man, and a boy to work it, and while it is an easy matter to spray as

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* *Entomosporium maculatum*, Lév. For an account of the life history of this fungus see Annual Report of the Commissioner of Agriculture, 1888, p. 357.

† Composed of equal parts of ammoniated copper sulphate and sodium carbonate.

rapidly with it as with the Little Giant, experience has shown that in the end it is more expensive on account of the extra labor involved in working it. A machine to be drawn by hand can readily be made, the materials required being a two-wheeled truck, a barrel, a force pump, hose, and Vermorel spraying nozzle. Such an apparatus can be constructed for $14 or $15. The nozzle is provided with a three-fourth inch screw attachment, and instead of the old style degorger we now fit them with the same kind in use on our lance.*

Returning again to a discussion of the experiments:

II. BORDEAUX MIXTURE.—*Three early treatments to five trees of Bartlett dwarfs.*—The sprayings were made on May 5, 16, and 28, sixteen gallons of the mixture being used. It required 35 minutes to do the spraying, and, estimating the labor at $1.50 per day, the cost of it is 17 cents, or 3.4 cents per tree. The cost of the material was 34.7 cents, or 6.93 cents per tree, making the total expense of treating each tree three times, 10.33 cents.

Results.—On October 6 the treated trees were in nearly perfect foliage while the untreated in adjacent rows had dropped most of their leaves.

III. BORDEAUX MIXTURE.—*Three late treatments to five Duchess dwarfs.*—The dates of treatment in this case were May 28, June 23, and July 8. Sixteen and eight-tenths gallons of the mixture, costing 35 cents, were used. The expense for labor was 24 cents, making the total cost of the sprayings 11.8 cents per tree.

Results.—On October 6 the trees still retained a large part of their foliage while the untreated had lost every leaf.

IV. BORDEAUX MIXTURE.—*Six treatments to five Bartlett dwarfs.*—The treatments were made on May 5, 16, and 28, June 10, 23, and July 8. Thirty-six gallons of the mixture were used and 87 minutes were required to do the work, making the cost for the mixture 15.1 cents per tree and the labor 8.7 cents, a total of 23.8 cents per tree.

Results.—The foliage was completely preserved up to the time the frost removed it. It was, however, in no better condition than that in experiments II and III.

V. AMMONIACAL SOLUTION.—*One treatment to two rows of Bartlett standards containing* 54 *trees.*—The treatments in this and the following experiments were made on the same dates as I, II, III, and IV; moreover, all the other conditions were practically the same. Forty-four gallons of the solution, costing 33 cents, were used. The cost of labor in preparing and applying was 45 cents, making the total cost 78 cents, or 1.44 cent per tree.

Results.—The foliage on September 24 was not as well preserved as that of I, but it was much more perfect than that on the untreated trees. On October 8 the leaves had nearly all fallen.

VI. AMMONIACAL SOLUTION.—*Three early treatments to five Bartlett dwarfs.*—Treatments made on the same day as II, 22 gallons of the so-

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* Illustrated in Vol. VI, No. 2, 1890.

lution costing 16.6 cents being used. The expense of application was 28 cents, making a total of 44.6 cents, or 8.92 cents per tree.

Results.—On October 8 the treated trees were in good foliage, while the adjacent untreated trees were leafless.

VII. AMMONIACAL SOLUTION.—*Five late treatments to twelve Duchess dwarfs.*—Treatments made May 28, June 10, and 23, July 8 and 19, 58 gallons of the liquid costing 43.5 cents being used. The cost of labor was 42.5 cents, making a total of 86 cents or practically 7 cents per tree.

Results.—On September 24, the foliage was only partially removed by the disease and the contrast, though not striking was quite apparent. On October 8 the contrast was much more marked.

VIII. AMMONIACAL SOLUTION.—*Six treatments to three trees of Bartlett dwarfs and four of Bartlett standards.*—Dates of treatments as in IV, 67 gallons being used at a cost of 50.2 cents. The cost of application was 58 cents, making a total of $1.08, or 15.4 cents per tree.

Results.—The standards showed the effects earliest and most markedly, but both held their foliage well into October while surrounding unsprayed trees dropped their leaves before the last of August.

IX. MIXTURE NO. 5.—*Six treatments to five trees of Bartlett dwarfs.*—Applications made the same as in IV, 36 gallons, costing 43 cents, being used. The cost of application was 45 cents, making the total expense 17.6 cents per tree.

Results.—The foliage was badly burned and many leaves dropped in consequence, but the leaf-blight was effectively prevented.

X. COPPER ACETATE.—*Three treatments to two Bartlett standards.*—The applications were made May 28, June 23, and July 8, using a solution of 3 ounces of the acetate to 6 gallons of water. Nine gallons of the mixture, costing 8.6 cents, were applied at an expense of 10 cents for spraying. The total cost therefore was 18.6 cents, or 9.3 cents per tree.

Results.—On October 6 the foliage was in a fair state of preservation, while adjacent untreated trees were leafless. No noticeable damage was done to the foliage, only an occasional leaf being injured.

XI. COPPER ACETATE.—*Six treatments to five trees of Bartlett dwarfs.*—Dates of treatment as in No. IV. Forty gallons of fluid were used, 4 gallons of a strong mixture (4 pounds to 22 gallons), and 36 of a modified (12 ounces in 24 gallons) solution, at a total cost of 62 cents, or 12.4 cents per tree. The cost of application amounted to 45 cents, or 9 cents per tree, making the total expense per tree 21.4 cents.

Results.—The leaves were severely injured, many of them falling long before the proper time. There is no doubt as to the fungicidal properties of this preparation; its use, however, can not at present be recommended.

XII. COPPER CARBONATE IN SUSPENSION.—*Six treatments to five trees of Bartlett dwarfs.*—The solution made by mixing 3 ounces of

copper carbonate in 22 gallons of water was applied on the same dates as IV. Forty-three gallons of the solution were used, but after the first two applications, which seemed to have little effect, the strength was doubled. The total cost of the treatments with this preparation was 13.3 cents per tree.

Results.—The disease was in a measure prevented, but the difference between the treated and untreated trees was not worthy consideration.

SUMMARY OF RESULTS.

Before summing up the results it is proper to state that the season was one exceedingly unfavorable for such an experiment, as the disease even on the untreated trees did comparatively little damage. We feel warranted, however, in drawing the following conclusions from the work.

I. The relative value of the preparations used in treating leaf-blight stand in the order named:

Bordeaux mixture.
Ammoniacal solution.
Copper acetate (3 ounces to 6 gallons).
Mixture No. 5.
Copper carbonate in suspension.

The difference between the Bordeaux mixture and the ammoniacal solution is scarcely perceptible, and if the cost is considered the latter stands first.

II. The best results at the least expense were obtained by the *early* treatments. It is well to add here that we do not accept this evidence as conclusive; on the contrary, we are inclined to think that had the disease been severe three treatments would not have been sufficient to hold it in check.

III. Early sprayings are unquestionably better than late ones.

IV. The cost of the various treatments will, in a measure, depend on the kind of spraying apparatus used, the distance from places where chemicals may be obtained at wholesale rates, and skill of the operator. It may safely be put down that for orchards of one thousand or more dwarfs the cost for treating with the Bordeaux mixture need not exceed 2 cents per tree for each application. For standards the cost will reach 3 cents or perhaps a little less.

In treating with the ammoniacal solution, which is the only additional preparation worth considering in this connection, the cost for dwarfs will average in the neighborhood of 1½ cents per tree and for standards 2½ cents.

From one season's work it is of course impossible to draw any definite conclusions as regards the direct benefit to the trees resulting from the treatment. It is reasonable to assume, however, that if the leaves on a tree, and especially a fruit tree, can be made to continue their normal work until frost, they will enable the tree to make a better growth, set more fruit buds, and consequently bear more fruit the

ensuing season than one which loses its foliage in midsummer. There is, however, a more important matter to consider in this connection, and that is the life of the tree itself. We know that in sections where the leaf-blight is severe a tree soon succumbs entirely to the disease. While we have no data bearing on the longevity of treated trees there is no room to doubt that they can at least be made to live their allotted time.

TREATMENT OF PEAR SCAB.*

These experiments were carried on in the same orchards and at the same time as those described in the preceding pages. Owing to the fact, however, that very little fruit set the work was far from satisfactory. At the time of the first treatment the fruit was about half an inch in diameter and stood erect upon the pedicels. The Bordeaux mixture, ammoniacal solution, mixture No. 5, copper carbonate in suspension, and acetate of copper were used, an effort being made in all cases to bring out, if possible, the relative value of the fungicides as preventives of the disease, the effect of early and late sprayings, the relative value of three and six treatments, and the cost of each application. Without going into the details of the work it may be said:

I. That in no case were the sprayings made early enough, as scab spots had already appeared on the fruit when the first applications were made. It was clearly evident that one spraying should have been made when the flowers were beginning to open and another when the fruit was about the size of peas.

II. There was no material difference so far as the amount of scab was concerned between the trees treated early and late and those which received three and six sprayings, respectively. By early here it must be borne in mind that we mean when the fruit was half an inch in diameter.

III. The costs of the treatments were found to be practically the same as those for pear leaf-blight. When one intends to spray for leaf-blight it will be an easy matter to begin earlier and treat the scab at the same time. In spraying for both of these diseases it would be well to make the first application as described above for scab, then follow with additional treatments at intervals of 12 or 15 days until six or seven in all have been made. In the present condition of our knowledge the Bordeaux mixture is the preparation most to be relied upon as effective against both leaf-blight and scab, and at the same time not injurious to the fruit. Should early treatments alone be made the case would be altered.

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* *Fusicladium pirinum*, (Lib.) Fckl.

THE PEACH ROSETTE.

PLATES VIII-XIII.

By ERWIN F. SMITH.

In the first bulletin on peach yellows some account was given of a peculiar peach disease prevalent in Georgia and not visibly associated with fungi. This account was based on correspondence and specimens received through the mails. In some particulars the specimens agreed exactly with yellows. In others they differed somewhat, and I was in doubt what it should be called. A full opportunity to examine it in the fields and orchards of middle Georgia in the summer of 1890 still left me with some doubt. It seems best, therefore, to call it "the peach rosette" until it can be determined whether it is identical with yellows, as now seems probable.

This disease agrees with peach yellows, as already defined, in the following important particulars:

I. On some of the trees winter buds and obscure buds push into diseased, branched growths identical with yellows. All ot the growths would be identical if the shoot-axes were elongated.

II. Winter buds show the same tendency to unfold in summer and autumn. I saw such immature, feeble growths as late as November 6.

III. Part of a tree may be affected while the rest appears normal.

IV. The disease can be communicated to healthy trees by inserting diseased buds. In my inoculations of June 21, sixty per cent of 125 stocks showed symptoms of the disease in four and one-half months.

The disease differs in the following particulars:

I. The entire tree is more apt to be attacked all at once, and the disease is more quickly fatal. Trees often die the first year, and I have not heard of any cases living beyond the second season. What corresponds to the first stage of yellows *seems* to be wanting.

II. On the parts attacked, many obscure buds and all or most of the winter buds push into diseased growths suddenly *in early spring.* The primary shoot-axes grow only an inch or two, but send out many short branches. This gives to each growth a compact tufted form, and to the affected tree a very peculiar appearance unlike anything heretofore described, and much resembling the work of insects. These stunted, green, or yellowish rosettes often form the only foliage of large trees, projecting from the ends of long, naked twigs like leafy galls, or like house leeks tied to the ends of sticks (see Pl. IX).

III. The lower leaves on these tufts or rosettes roll and curl, turn yellow, dry up at the ends and edges, and fall early. They begin to drop before midsummer, and a slight jar shakes them off by the hundred.

IV. On the trunk and base of the main limbs it is rare to find anything more than rosettes, and often these also are wanting, the diseased growths being confined to the extremities of the branches.

V. Diseased trees seldom bear fruit of any sort. Most growers deny that such trees ever bear premature fruit, but one man who has lost two orchards insists that he has seen it. No fruit could be found in Georgia peach orchards in 1890, and this point was necessarily left unsettled

VI. The disease occurs in wild and cultivated plums, to which it is quickly fatal. Thousands of the wild Chickasaw plum (*Prunus Chicasa*) have been killed by it during the last few years. I also saw it in two Japanese varieties—Kelsey and Bhotan—and in one or two American varieties probably derived from *P. Chicasa.*

If this malady is yellows, our definition of that disease must be somewhat modified and enlarged to include the plum or at least certain varieties of it. My previous statements relative to the immunity of the plum were based on observations north of Virginia and had special reference to varieties of *Prunus domestica.*

This disease has been in upper middle Georgia for at least 10 years, and during this time has destroyed whole orchards. With some noteworthy exceptions it has not swept away budded orchards as quickly as the yellows of the North, but it takes some trees every year, and is evidently a dangerous enemy. This is true especially, because of its prevalence in the hardy wild plum which grows everywhere. During my visit I saw the disease in twelve counties: Fulton, Clayton, Campbell, Henry, Spalding, Pike, Meriwether, Coweta, Troup, Talbot, Harris, and Muscogee, and heard of it in ten others: Upson, Monroe, Bibbs, Butts, Jasper, Putnam, Greene, Taliaferro, Morgan, and Oglethorpe. It is widespread and well established in that part of Georgia.

The disease attacks cultivated and neglected orchards, young and old trees, seedlings and budded fruit. If anything, it is more prevalent in thickets and waste places, the edge of forests, and on the borders of streams, or by the wayside, than in orchards. It is not restricted to any special kind of soil or prevented by any method of cultivation. It occurs on the common red clays, on the gray and granitic sandy lands, and on a chocolate-colored, deep, fertile loam, commonly called "mulatto land."

A disease which appears to be identical (see Pls. XI–XIII) occurs also in Kansas. So far as known, it is now present only at Manhattan, and has not yet appeared in the important peach districts of southern and southeastern Kansas.

The attention of the writer was first directed to the disease by Mr. T. C. Wells, who sent specimens in 1889. The malady continued in 1890, when Dr. Kellerman also sent specimens and made inquiries. Later in the year I was able to examine it more carefully in the orchards themselves.

The farm of Mr. Wells is in the Kansas River valley, on a fertile, rolling prairie, about midway between the bottom lands and the limestone hills, *i. e.*, on what is called the "second bottom." The soil is a dark and a very deep loam, gradually shading into a reddish brown,

clay subsoil. In moist seasons this soil yields from 40 to 60 bushels of shelled corn. Apples, plums, grapes, elms, negundos, etc., also grow in it vigorously. The soil must contain plenty of lime, since horizontal, eroded ledges of limestone crop out everywhere on both sides of the Kansas valley for miles and miles.

This orchard of choice budded fruit contained only about two hundred trees, but they had always been thrifty and well cared for. The older trees were 8 to 12 years old and had borne several good crops; the younger (about fifty replants) were 4 to 6 years old and had borne only one crop.

Mr. Wells first noticed this disease in 1889. He says there were no cases in his orchard prior to 1889. That year more than 75 per cent of the trees became affected in whole or in part. The disease appeared in the spring and most of the trees were dead or dying when cut down the following autumn. A very pestilence seemed to have stricken the orchard.

In August, at the time of my visit, only about fifty trees remained. These were replants, 4 to 6 years old, and had been thrifty. Dr. Kellerman and Mr. Swingle carefully examined them in July, 1889, at which date about one-half were healthy. Dr. Kellerman accompanied the writer in an examination and we could then find only two healthy trees. The rest were diseased in the same way as the cases of the previous year—some were dead and the others showed symptoms throughout or on a part of the tree only. All trees which were noted as affected in July, 1889, were dead or dying.

Neighboring orchards were almost as badly affected. Most of these were neglected seedling trees in sod ground. About one hundred cases were also observed in a peach thicket where the struggle for existence was severe. In none of these places could I satisfy myself that the disease had been present more than two seasons, and the question of its origin is exceedingly obscure.

As in Georgia the terminal shoot-axes were developed into tufts all over the tree, but usually these were somewhat less compact. None of the peach trees had developed any luxuriant branched growths on the trunk or base of the main limbs as is common in the yellows of Maryland and Delaware, but the winter buds were pushing in the same way. Last year some of these trees bore fruit, but I could not learn that any of it ripened prematurely. Frequently one-third to two-thirds only of the tree was visibly affected. Occasionally trees would be diseased, dwarfed, and yellow throughout, except one or two small terminal shoots in the top of the tree. These, in striking contrast, bore leaves of normal size and color. This also happens in Maryland and Delaware in ordinary yellows.

This disease was also observed in cultivated plums of the Chickasaw type and in the hard shell almond. I have no hesitation in saying that it is identical with the disease which occurs in Georgia.

This rosette disease resembles yellows very closely, to say the least, and there are transition forms in both States, and growths not distinguishable from genuine yellows. The absence of the prematurely ripened fruit may be due to the suddenness and severity of the attack. The long, dry summer or other climatic peculiarities of these two regions may possibly account for this, and also for certain other symptoms at variance with the yellows as heretofore known and described. These are points to be worked out hereafter.

The disease in Georgia has been erroneously attributed to the attacks of Scolytid beetles. * *Scolytus rugulosus* is common in Georgia, and rather destructive, but in June the mother beetles were only just commencing to burrow into the bark preparatory to depositing their eggs, *while the trees had been affected with this disease for several months.* Moreover, in June there were many diseased trees which had not yet been attacked by a single beetle or had only a few borings. To satisfy myself I examined some of these carefully over every square inch of their surface; cut the bark open in every direction, and examined each one of several thousand rosettes, *e. g.*, the tree figured on Plate IX. In July it was more difficult to find such trees, although not impossible, *e. g.*, on June 30, in company with Mr. Rudolph Œtter, I examined four trees in a middle-aged, seedling orchard near Griffin, Ga., with the following results:

(1) This tree was nearly dead and the rosettes had a droopy look. In a section of one limb, which was not over 1½ inches in diameter and 2 feet long, we found 83 excavations made by *Scolytus rugulosus.* The beetles were present and burrowing in most of these holes, but not yet buried out of sight. The evidence of recent occupation was strong.

The tree probably contained a thousand beetles, but most of them had been at work only a few days. They had bored into the base of many of the rosettes, and this was what gave to the foliage its wilted, drooping appearance. This tree died in July, 1890. It was probably attacked by the rosette disease in 1889.

(2) This tree was diseased in all parts, and did not bear a single full grown leaf or shoot-axis, but the rosettes were still green and fresh. This tree was even more minutely examined than the preceding. In the trunk and main branches there were no beetles, no holes, and no internal borings or chambers. There were also very few injuries on the smaller twigs,t he most careful search bringing to light only half a dozen.

(3) This tree contained many beetles. The foliage was wilted and drying up as in No. 1.

(4) This tree was like No. 2 in appearance. It was also like it in being almost completely free from beetles or borings due to them.

No larvæ or pupæ were found in any of the trees.

It is wholly impossible to account for several thousand diseased growths scattered over the whole top of a tree by the slight borings of a few dozen beetles, even admitting their constant presence in the

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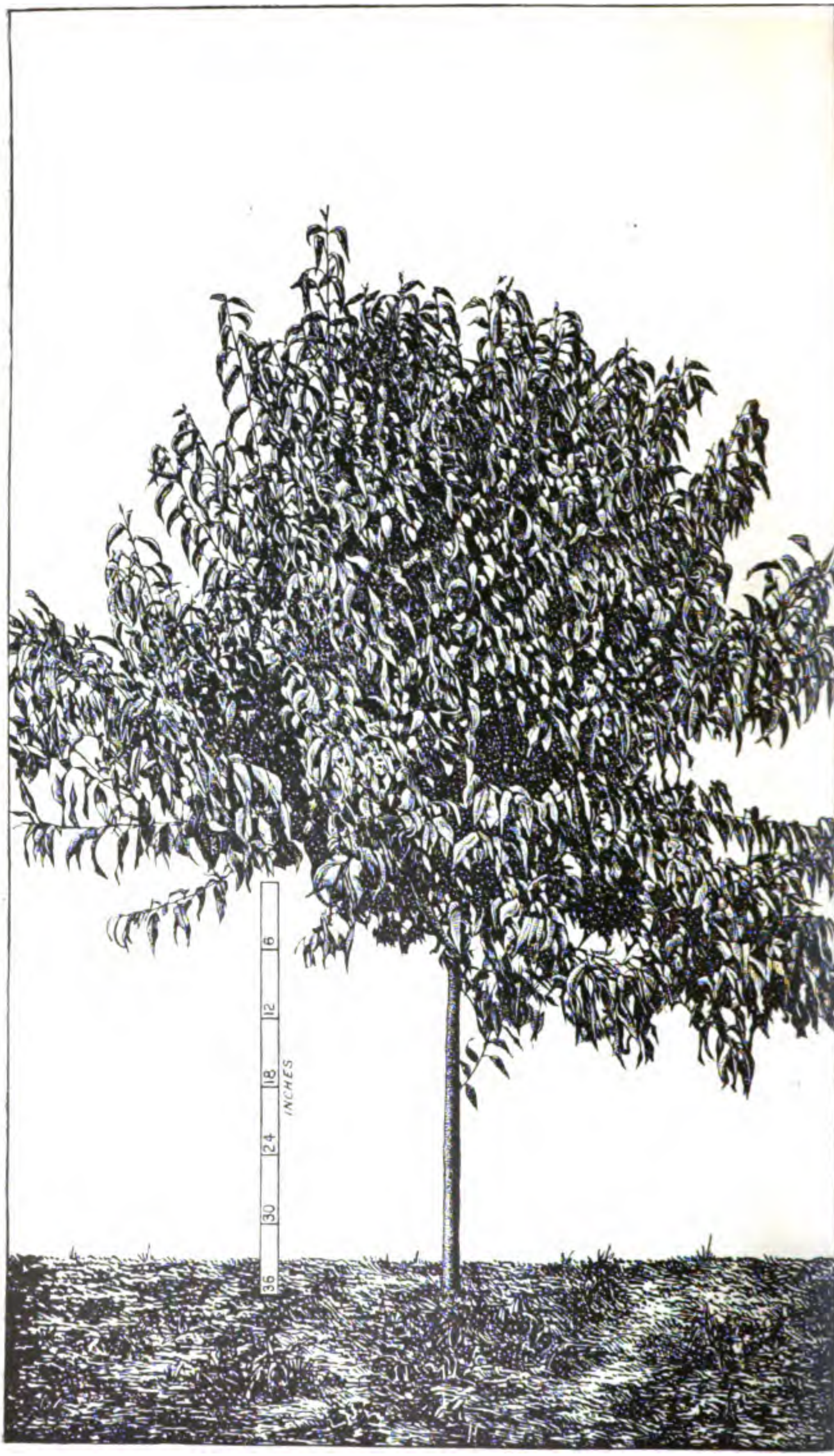
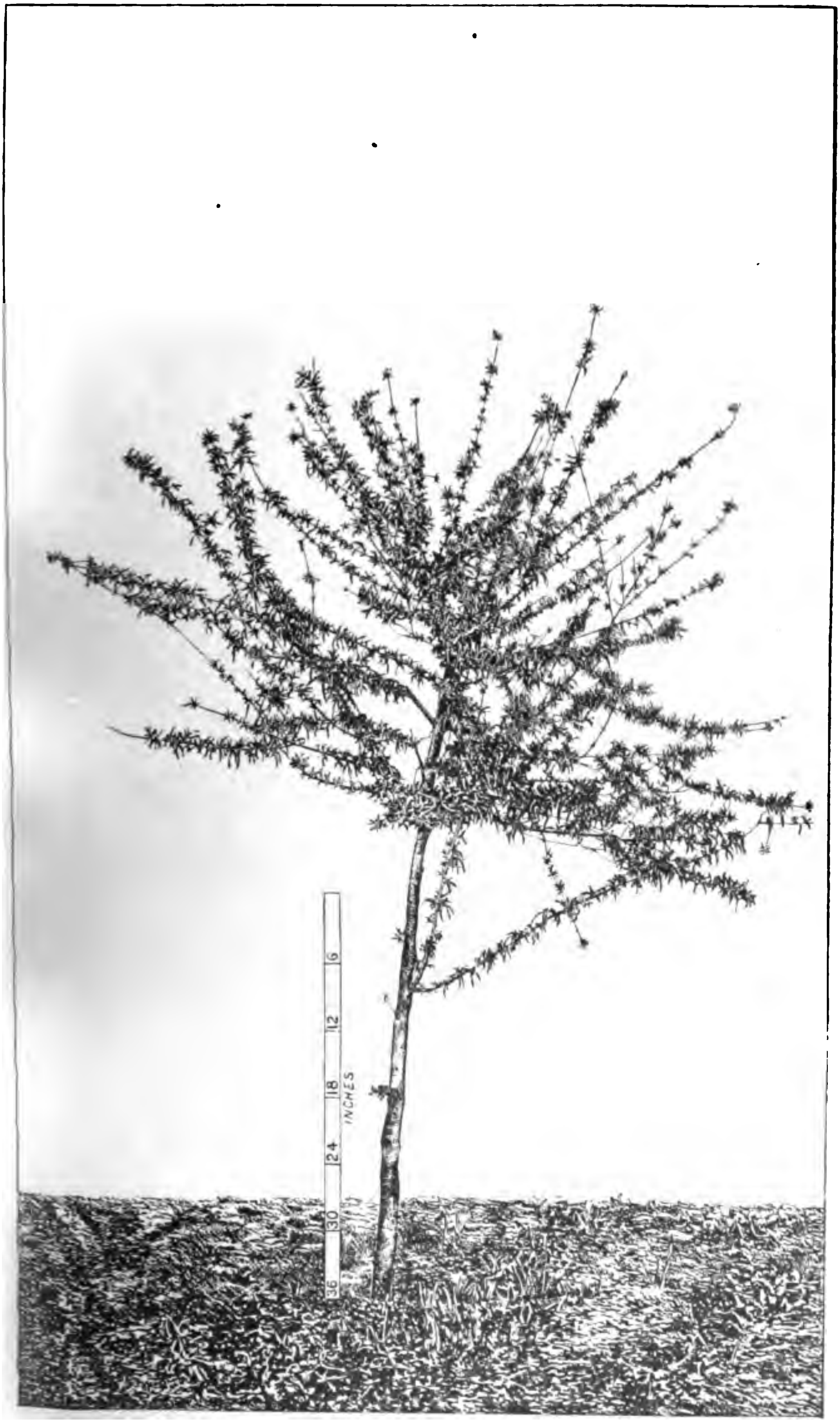
* *Proc. Georgia State Hort. Society,* 1889, pp. 16 and 46.

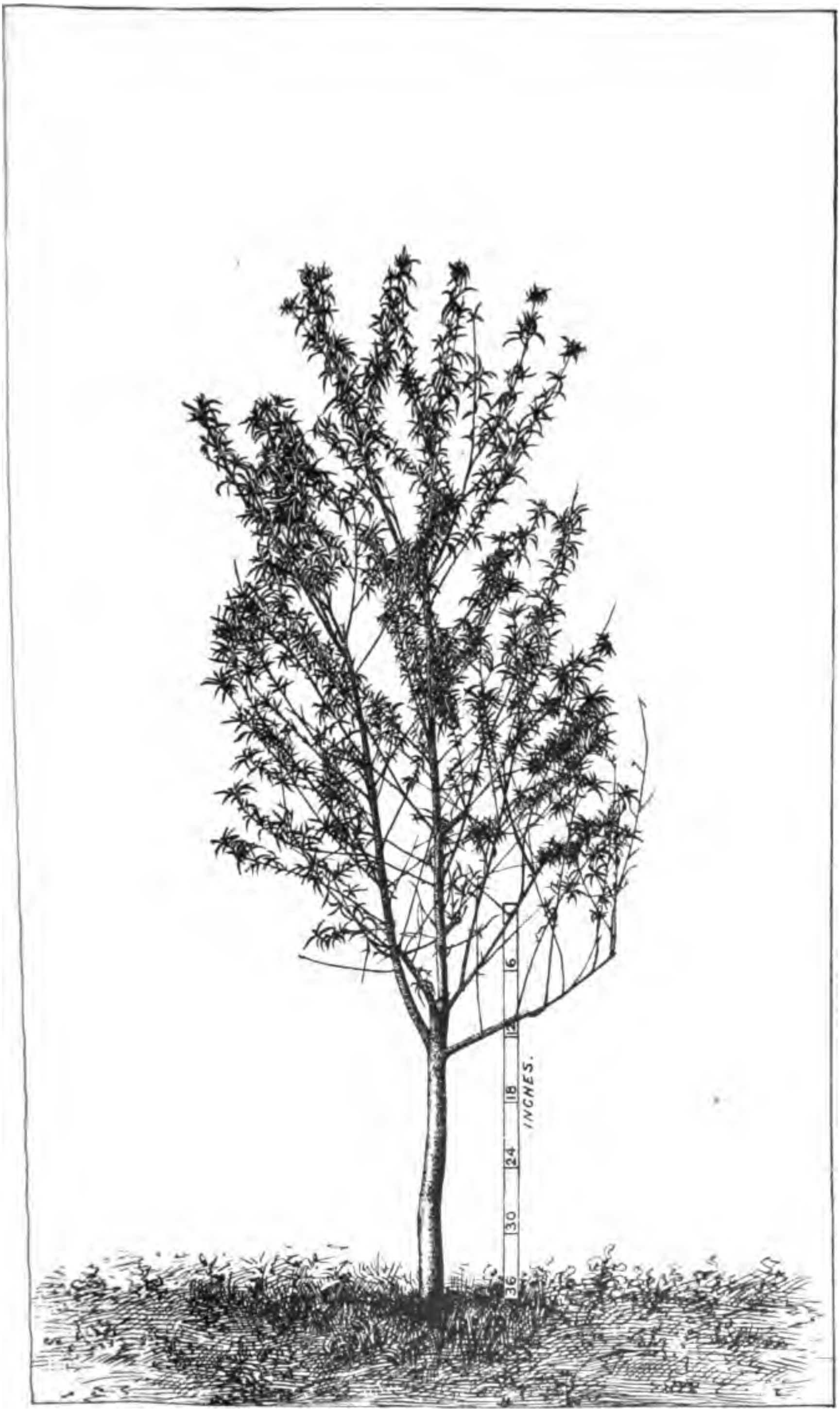


HEALTHY PEACH TREE.—GEORGIA.



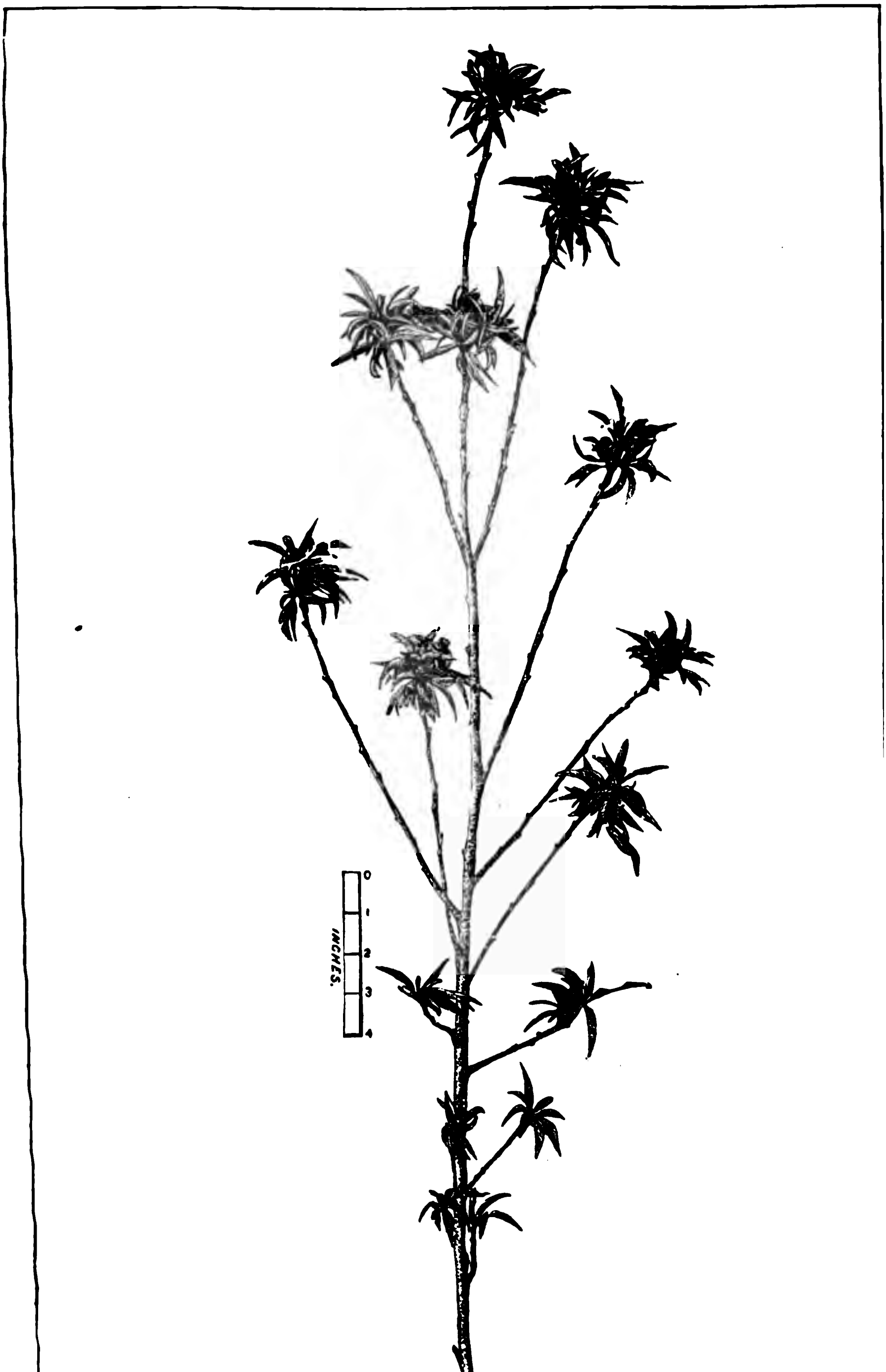
THE ROSETTE.—GEORGIA.

THE ROSETTE.—GEORGIA.



THE ROSETTE.—KANSAS.

THE ROSETTE.—KANSAS.



THE ROSETTE.—KANSAS.

early stages of the disease, which is by no means the case. As a rule, beetles of this group prefer sickly trees. Late in the season many such trees were riddled by *Scolytus*, but they did not appear in numbers until June. The time to make such an examination is in the spring when the disease first appears and not in summer or autumn when the trees are nearly dead. In spring, when the cause of this rosette disease is very active, the *Scolytus rugulosus* can do no harm, because it is then undergoing transformations in the trees which were attacked the previous year. Larvæ and pupæ were taken from a number of such trees. They were generally in winding passages in the wood, and were most abundant in some plum trees not suffering from this disease.

Moreover, repeated observations in Kansas during a two-weeks' visit failed to discover a trace of this insect. Neither had the Experiment Station entomologists ever seen it. The probabilities, therefore, are that this species has not yet appeared at Manhattan.

The *Scolytus rugulosus* does not cause this disease, nor do I think it due to any other insect. Whatever be its cause, the disease is evidently increasing, and peach-growers should be on the alert to destroy it as soon as it appears. The affected trees should be dug out and burned as soon as discovered. The contagious nature of the disease is now beyond dispute, and it is not wise to let them remain a single day.

EXPLANATION OF PLATES.

PLATE VIII. Healthy peach tree from an orchard of budded fruit near Griffin, Georgia. Set 2½ years. This tree stood upon cultivated, level, fertile "mulatto land." Photo, June 28, 1890.

PLATE IX. Tree attacked by the rosette—a typical case. This tree stood in the same orchard as VIII and not over 20 feet distant. It was healthy in 1889. Photo, June 28, 1890, at which time it did not bear a single leaf or shoot-axis of normal character. The bark on the trunk of this tree had been injured by a borer (*Ægeria exitiosa*, Say) but over an area not larger than a silver dollar. There were no other injuries by borers; no bruises, and no borings by *Scolytus* anywhere on the trunk or main limbs. To determine the amount of twig injury attributable to *Scolytus*, I examined each one of the several thousand tufted and growing shoot-axes, and all of the internodes, finding three beetles and fifty slight injuries. All these were of recent date, and many did not reach into the cambium. There were no larvæ and no winding passages under the bark. Usually the gnawings were at the base of the tuft on the upper side in the acute angle formed by the shoot and the older stem. These injuries were generally vertical and seldom over one-eighth of an inch long or broad. In no case was a twig of the previous year's growth girdled or so injured as to affect shoots above the boring. The worst injuries amounted simply to the killing of the particular shoot-axis bored into. These had dried up and were easily distinguishable from the uninjured majority. The fact that the dead shoots were nearly as large as the rest showed clearly that the injuries were of recent date, whereas the tree had been diseased throughout for several months, *i. e.*, ever since it began to grow in the spring. The fifty injuries by the beetles were not more serious than would have been a like number of stabs with an awl. Later in the season no doubt the tree might have been full of beetles and larvæ.

PLATE X. Rosettes from a seedling tree near Sunny Side, Georgia. This tree showed symptoms of disease on only about one-half of its branches. On some of the branches the winter buds had germinated, especially toward the upper ends of the shoots. Photo, July 2, 1890.

PLATE XI. Diseased peach tree from the budded orchard of T. C. Wells, Manhattan, Kansas. Much smaller than the average. Healthy in 1889, but now affected in all parts. There were no injuries by borers, root aphides, root knot, or *Scolytus*. The winter buds were germinating on some of the tufts. Photo, August 16, 1890.

PLATE XII. Diseased branch from a seedling tree in the orchard of W. J. Griffing, Manhattan, Kansas. Whole tree affected in the same way. An extreme case of tufting. Photo, August 23, 1890.

PLATE XIII. Diseased branch from a seedling tree in the orchard of W. J. Griffing, Manhattan, Kansas. The whole tree was affected. Photo, August 18, 1890.

TUBERCULOSIS OF THE OLIVE.

PLATES XIV, XV.

By NEWTON B. PIERCE.

During the summer of 1890, I enjoyed the opportunity of meeting, under the most pleasant circumstances, Dr. Luigi Savastano, professor of arboriculture of the Royal High School of Agriculture, at Portici; the latter a beautiful town situated at the base of Vesuvius, on the shores of the Bay of Naples. Dr. Savastano has recently done some excellent work on the tubercle disease of the olive, having conducted several series of experiments with cultures and inoculations which have resulted in clearly demonstrating the bacterial nature of this most interesting malady. These experiments have been carefully repeated by Dr. Fridiano Cavara, of the well-known agricultural school of Pavia, south of Milan. The result has been equally conclusive and interesting. It was my good fortune and pleasure to meet both Drs. Briosi and Cavara of this school, and to have the opportunity of seeing much of their valuable work. The writer was shown an olive tree into which bacilli of the olive tuberculosis had been introduced, and which was showing at the points of infection well-developed tubercles. At its side stood another olive of like size and similarly conditioned, which had been treated in all ways as its companion with the exception that the wounds made by the knife had never received the germs. No signs of a tubercle were to be seen upon this tree. The organisms used in these experiments were from artificial cultures.

During the author's labors in the Mediterranean region, tuberculosis of the olive was encountered at several places and under various conditions. On this account the liberty is taken to append a note or two to a translation of the published account of the concluding experiments of Dr. Savastano.* There is also given a reproduction of figures pub-

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* *Il Bacillo della Tubercolosi dell' Olivo, Nota Suppletiva del dott.* L. Savastano. Roma, 1889.

lished by Drs. Cavara and Briosi, showing the section of a tumor with the location of the bacilli in the tissues, as well as the germs themselves as seen in the stained preparations on the slide. I was shown while at Pavia the preparations from which the sketches were drawn, and will say they are fairly represented in the figures given. To supplement this there have been added figures from my own material and photographs of affected olive branches, showing the location and various stages of the tumors *in situ*.

Dr. Savastano's account of the disease is as follows:

In my study of the tuberculosis of the olive (commonly *scab of the olive*)* I established the presence of a pathogenic microörganism in the tumors, cultivated it, inoculated with it, and obtained by means of it the formation of tumors. I explained that owing to circumstances over which I had no control I was unable to complete the study of this microörganism with the thoroughness which bacteriology requires. Having obtained the means for undertaking the researches in the bacteriological laboratory of the Zoölogical Station at Naples,† I have resumed the study which I was reluctantly obliged to leave incomplete.

The characteristics of the pathogenic microörganism of the tuberculosis of the olive are the following: The cultures are made in a way to avoid error only when incipient tumors are used. If they are made from old tumors it is necessary to take the inner part of the cambium zone. Taking the external part, only the microörganisms of the air are found.

This microörganism is a Bacillus of medium size; length three to four times its width; it is isolated, but is sometimes joined into chains; the extremities are slightly rounded off. In drops of bouillon it has a distinct movement. The colony has a variable form, from round to oval, with a well-defined margin. In the beginning it is uniformly pointed; later it forms one or two peripheral circles. It is whitish by reflected light, cedar-color by transmitted light. The bacillus lives well in ordinary culture media (bouillon, potato, gelatine, agar). I have attempted to make another medium for culture with material taken from the olive. It did not prove very suitable, and the preceding media are preferred. Gelatine does not liquefy in our climate from January to April; from May to June it liquefies slowly. The culture has a relatively long life; cultures made in March were still living in June. In short, degeneration begins in about 3 months. The bacillus stains very well with simple aniline colors. I have not been able to establish a distinct spore formation. The method of double staining does not succeed very well, because the cell wall takes up the aniline colors more easily and gives them up with greater difficulty than the microörganisms.

On the potato it lives very well and develops rapidly; the colonies are at first like so many small round dots, translucent straw-color, which, as they develop, form on the surface of the potato a uniform stratum, translucent, and of a deeper color. The bacillus acquires greater dimensions.

On the gelatine plates it lives very well, with characters and forms as above indicated. In tubes of gelatine *a becco* the culture presents the appearance of a uniform stratum, whitish, the margin finely bilobed, reminding one of the margin of a leaf, the whole culture taking the form of a spatulate leaf. It is slightly dichroic.

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* *Tubercolosi, iperplasie e tumori dell' olivo. I. II. Memoria.* Annuario R. Scuola Sup. d'Agricoltura in Portici, Vol. v, fasc. 4, 1887.

† The equipment for bacteriological work in the Naples Station has been but recently added, we believe. The station now has the facilities for doing good work of this class. Mr. H. Linden, in charge of the station, who has our thanks for courtesies extended during our stay at Naples, fully convinced us, after a careful inspection of the laboratories and general accommodations of the institution, of the desirability of more American students reaping the benefit of the advantages there offered.—N. B. P.

In tubes of agar *a becco* the culture is indentical with the preceding, the margin is less bilobed.

The culture by needle in gelatine presents a uniform, transparent, finely pointed appearance. On the surface of the meniscus the form is irregularly rounded with a finely lobed margin as in the preceding.

In the different materials taken from the olives of Puglia, Calabria, the Vesuvian region, and the Sorrentine peninsula, I have demonstrated in each case the same microörganism in the cultures.

In tumors which had been gathered about a year the Bacillus had been destroyed.

In the cortical tubercles and in their miliary form I have demonstrated the same Bacillus. I have performed three series of inoculation experiments. I have practiced the same method of inoculation which I had before adopted.

Series I. Inoculation of pure cultures in olive plants.—The plants used were all grown from seed, some were raised by myself, others were given me by Signor R. Pecori, of Florence, from his establishment. The plants were taken from seed and not from cuttings, to avoid heredity from the mother plant which might be infected.

The inoculations were made April 27 of the current year. By the 1st of June the tumors were already evident, and by the 1st of July were much developed. The controls have not given signs of tumors. These results are the confirmation of those obtained roughly by me and with impure cultures in 1887. I am able to conclude that *the disease of the tuberculosis of the olive* (commonly scab) *may be produced by a specific pathogenic Bacillus which I name Bacillus oleæ-tuberculosis*, understanding the tubercle in the sense of botanical pathology.

Series II. Inoculations of the Bacillus in other plants.—The conditions of inoculation are identical with the preceding and on the same day in the following plants: peach, plum, apricot, grape, fig, pear, apple, bitter orange, lemon, rose, *Abies excelsa*, *A. pectinata*, *Cedrus Libani*. Till now (July 30) I do not see the least sign of a tubercle; the wounds are perfectly closed and healed. I am able to conclude from this that *these bacilli are not able to produce the same pathological effects in the plants indicated.*

Series III. Inoculations of other microörganisms in olive plants.—With the identical conditions preceding I inoculated into olive plants the following microörganisms which I am studying in the said Zoölogical Station: (1) A bacillus obtained in small tubercular swellings of the plum; (2) a second bacillus obtained as the preceding; (3) a bacillus found in the gums of citrous plants; (4) one of the bacilli of the pus of the citrous plants; (5) a bacillus of the cancer of the vine. Not one of the many inoculations has produced a tumor. Could this be done the tuberculosis might be produced by any microörganism whatever. *This third series of experiments indicates much more certainly the pathogenic power of the Bacillus of the tuberculosis of the olive.*

General observations.—The tubercle of the olive is an excrescence upon the limb of the tree which might pardonably be at first mistaken for an insect gall. These excrescences or tumors are quite variable in size, probably most of them are mature before reaching an inch in diameter, but some become large coarse knots. Many branches cease to grow, in whole or in part, beyond the tubercle, after the latter has become partially developed. Some branches become stunted while others die entirely toward the end. Hence the growth of the tubercle is largely limited by the vigor and life of the limb bearing it.

Dr. Savastano says* that the tubercles occur upon branches from 1 to 15 years of age. In forming, the tubercle commonly takes its origin quite near the cambium zone, though more frequently the center of bacteria begins to form in the liber portions of the fibro vascular bundles. To the unaided eye the forming center appears like a very small

* *Comptes Rendus.* Paris. T. CIII, p. 1144.

transparent spot, which, under magnification of 1,000 diameters shows the colony of bacteria already formed. There is now manifest about the colony a hypertrophy of the elements which may become more or less profoundly altered. As the colony enlarges the hypertrophy increases. The tubercle grows until in time it cracks through the exterior bark. When the tubercle is formed its growth is not usually arrested, but it continues to increase more or less in size each year, often attaining a diameter of 0.01 to 0.02 meter (two to four fifths of an inch). The tubercle is formed in the spring; during the heat of the summer the hypertrophy is arrested, but the colony of bacteria increases considerably. Then, during the autumn renewal of growth the hypertrophy begins again.

The irritation or stimulation caused by the presence of the bacillus, so far as our observations have extended, produces only a localized growth of tissue. There is scarcely more evidence of a general or constitutional disorder of the sap of the tree affected than is produced in the oak under the action of the Cynipidæ. The stimulation of the affected branch scarcely extends beyond the node or internode where the swelling occurs. The impoverishing action of this growth, however, is often plainly observed on the entire twig beyond the tubercle. The limb sometimes shows a marked reduction in diameter, though perhaps green and healthy in other respects. In a majority of cases the enlargement only involves one side of the branch. It is not uncommon to find two centers of inoculation producing coalescing tubercles; but the distinction of origin is rarely lost. So far as I am aware progressive death of the limb below the point of infection, as is the case with pear-blight, never occurs. There is no analogous and general pathogenic degeneration of the tissues as found in limbs affected by that disease.

From some of my first observations, where I found the tubercle developing at the node of the limb, I thought it likely that inoculation had been effected by means of the axillary buds. Later, however, many tubercles were noticed, located upon internodes, and having no connection with the leaf axil. This has left the method of entrance of the Bacillus obscured, unless, perchance, it be through the growing point, and continued growth has left it within the internode or at the node. This explanation seems more probable than that the organism has directly penetrated the bark of the branch. It is also rather indorsed than otherwise by the fact that whenever mechanical injury has occurred to the bark, laying bare the cambium tissue, the tumors are often unusually numerous. They are most common where a bud or leaf or branch has been broken off, or where some injury or splitting of the branch has occurred. In one case observed, where a branch had been split for a few inches, three distinct centers of inoculation were seen at the edge of the ruptured bark within the distance of 2 inches. Undoubtedly, however, inoculation may occur through slight cracking or other injury of the bark.

The local and general distribution of tuberculosis of the olive is peculiar and interesting. There is no such sweeping and complete infection accomplished by this disease as is the case in the spread of many germ diseases. I was told that near Genoa the disease is very common and quite destructive. At Rome I visited an olive grove near Colonna, some 16 miles from the city and north of the Alban Hills. In company with Professor Cuboni I made careful search for this disease, and only obtained a single tumor from a considerable number of trees examined. Another case somewhat similar occurred at Portici. The agricultural school building there was formerly a royal residence, and retains back of it an extensive park which was fitted up in connection with the residence or palace. Here is an extensive olive grove. Dr. Savastano, his assistant, and myself searched through this grove for some time for tubercles, only finding, at last, a few on the upper limbs of a single tree. At Cancello, some 12 to 15 miles north of Vesuvius, is a large olive grove covering the hills at that place. I here spent several hours in a fruitless search for this disease; at Palma, about an equal distance southeast of Cancello, the trees were quite badly infected. Upon a single small branch (the one shown on Plate XIV) I counted not less than twenty-nine swellings. All about the hills north of Messina, Sicily, especially in the neighborhood of Faro, the olives are badly infected, and in one or two cases nearly the entire top of the infected tree was ruined. In the province of Syracuse, where olives are largely grown, and where they are very old and thrifty,* no signs of this disease were seen. At Palermo, northwest Sicily, it was again encountered, and noted as being the worst phase of the disease seen up to that time. In Algeria I did not encounter the trouble, but have little doubt of its existence there, as well as in all of the Mediterranean olive-growing countries. It exists in France. My observations show me that the disease is very irregular in its distribution. One olive grove may be free from it, or nearly so, while another not far distant may be badly infected. One tree in a grove may be, apparently, the only one infected. Again, the disease may be localized upon one portion of a single tree. Probably nothing short of a clear understanding of the means of distribution and infection will explain these facts.

Careful attention to the excision of all affected branches is apparently all that is required to keep this affection from spreading and doing serious damage.

As the olive industry is becoming one of importance on the Pacific coast, it is well that those interested should have the facts relative to the various enemies of that industry placed before them. In this way they may become familiar with those diseases not yet affecting their groves, and may take steps which shall prove an ounce of prevention worth more than a pound of cure.

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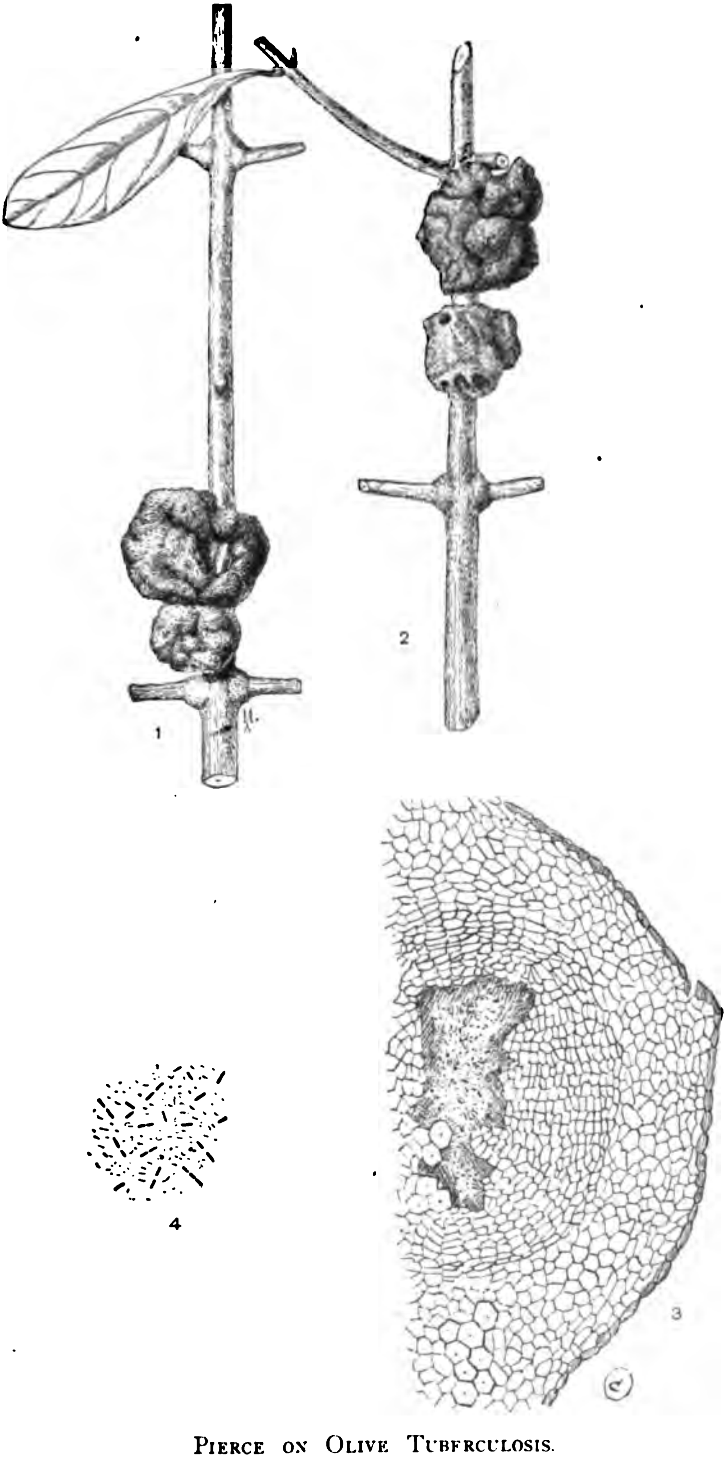
* Near Floridia, some 14 miles west of Syracuse, I found one magnificent old olive tree in perfect health, which measured 13 feet in diameter at the ground and 10 feet in diameter at 3 feet above the ground.

PIERCE ON OLIVE TUBERCULOSIS.



PIERCE ON OLIVE TUBERCULOSIS.

EXPLANATION OF PLATES.

OLIVE TUBERCULOSIS.

PLATE XIV. Olive branch 18 inches long, bearing 29 tubercles, only part of which are seen in the plate, and none are fully matured. Several of the tubercles have but recently broken through the bark of the branch. This branch was cut July 29, 1890, from a badly infected olive tree growing in an old grove two miles south of Palma, in the province of Naples, Italy. Photograph of fresh material.

PLATE XV. FIG. 1. Well-matured olive tubercles of natural size, showing the usual ruptured condition of the top. The rupturing is preceded by a slight pitting at the surface, as shown in the lower tumor. Material from near Genoa, Italy.

2. Olive tumors from the same source as those of Fig. 1. The lower tumor shows an opening through which some insect has escaped, which inhabits the old tumor, and which may assist in spreading the disease.

3. Section through a tumor. Shows the hypertrophy of the tissue and the degeneration at the central part of the tumor where the bacilli are situated. After Briosi and Cavara.

4. *Bacillus oleæ* (Arcangeli), Trevisan. From figures of stained slide preparations by Briosi and Cavara. I have seen the original preparations given in Figs. 3 and 4.

RECENT INVESTIGATIONS OF SMUT FUNGI AND SMUT DISEASES.

AN ADDRESS DELIVERED BEFORE THE SOCIETY OF AGRICULTURISTS OF BERLIN, FEBRUARY 17, 1888.

By DR. OSKAR BREFELD.

Full Professor of Botany in Münster in W.

Translated from *Nachrichten aus dem Klub der Landwirthe zu Berlin*, Nos. 220-222, by Erwin F. Smith.

(*Continued from p.* 71.)

For the solution of the first question some important data have been pointed out already in speaking of the mode of infection, to wit, the application of the germs and their penetration into the host. From the results of the first five series of experiments it is evident that the period of receptivity in the seedlings is very transitory. The slower this stage of growth the more probable it is that the germ which has penetrated at the right spot will actually reach the growing point in the given time; and this must be reached if the nascent blossoms and fruits (the subsequent location of the smut beds) are to become smutty. On the contrary, the more rapid this stage of growth the less must be the probability that the germ can reach the growing point in the short time before the seedling begins to elongate. And from this point of view the most extreme case would be when a very greatly hastened development of all seedlings altogether prevented the passage of the penetrated germ into the growing point; in this case, in spite of all penetrated germs, the appearance of the smut diseases would be impossible.

Now, in the first place, the rate of development of seedlings may be very different for different kinds of plants, and in general it may well depend on this whether they are or are not susceptible to smut diseases;* furthermore, in the particular forms which are attacked, it may fluctuate noticeably according as they belong to special races or sorts, and consequently these are more or less receptive. But more than all this, in particular individuals of the same species of cultivated plant a somewhat hastened or retarded development during germination will assert itself in smaller fluctuations, which here nevertheless may be decisive. For this reason it seems only natural that the receptivity toward smut fungi will be individually different, that consequently in the same material, under otherwise similar conditions, only a portion of the host plants will become smutty, as was actually the case in our experiments. The fungous germs certainly penetrated into every seedling, but the growing point was not reached in all cases, and only those finally became smutty in which it was reached. To what extent the temperature may influence the result I will only point out briefly. Warmth hastens development, but whether it acts equally on the growth of the seedlings and on the fungous germs in them had to be decided by infection experiments conducted at higher temperatures than those here described. These supplementary experiments showed that when seedlings, as in I, were infected at 15 degrees C. only 3 per cent of the plants became smutty, while at still higher temperatures only 1 to 2 per cent appeared or no smutty plants whatever. † The higher temperature, therefore, hastens the growth of the seedling proportionately more than that of the fungous germ, and thus hinders the development of smut in the plants.

It now remains to ascertain the reasons why, in all the series of experiments, not a single one of the infected barley seedlings produced a smutty plant. In the first place, it is self-evident that the negative results with the barley can not change in the least the positive results with the oats. On the other hand, without further inquiry, the explanations given for the incomplete sickening of the oat plants are by no means to be urged

* From the sum of the experiments and the preceding observations it follows naturally *that the simple penetration of the germ into the host plants*, on which the school of De Bary laid such stress, is not decisive for the appearance of smut diseases. But beyond this, I have by special experiments determined *that the most diverse smut germs can penetrate into all sorts of plants, which are never attacked by smuts*, consequently, the penetration of the germs only proves an unimportant detail. The results of these many experiments establish the accuracy of the views and conjectures on parasitism and the way it may occur in nature, of which I have already spoken in *Den Brandpilzen* I, p. 26–29.

† In the paniculate heads of the oat, sound spikelets sometimes occur at the tip of a panicle while the lower spikelets are destroyed by smut. In such cases the penetrated smut germs had not reached the uppermost point of the inflorescence when the elongation began; therefore these remained sound while the lower were attacked by smut. The correctness of this interpretation of the interesting discovery is shown by the fact that in such partially diseased panicles the *uppermost portions without exception are sound and the lower are diseased*, but never do the upper become diseased while the lower remain sound.

for the entire immunity from smut observed in the infection experiments with barley, and especially because barley in the field is more frequently attacked by the dusty smut than oats. The results remained a complete enigma for three long years. But then this case also was explained as naturally as imaginable.

I received accidentally from Yòkohama, through Chief Brigade Physician, Dr. Kügler, some smutty spikes of barley. It occurred to me that it was worth while to see whether the dusty smut on the barley in Japan agreed exactly with the dusty smut in Germany. I therefore sowed its spores, which in shape and size were indistinguishable from our own dusty smut, in nutrient solutions. Here it came to pass that in the universal germination of the smut spores into a promycelium *no conidia* were produced upon the latter, although they appear in countless numbers, as we know, in the spore germination of our own dusty smut. The promycelium afterwards branched in the same way, and just as abundantly, as any mold, but in a purely vegetative manner, without any formation of conidia.

In this manner mycelial masses were produced of such dimensions as can scarcely be derived from Saprophytes upon slides. As soon as the nutrient solutions were exhausted the remotest threads grew out stolonlike, and spread to a great distance, just as I have described and figured it for several fungi in my cited book. *The smut on the barley in Yokohama is therefore a fungus distinct from our dusty smut.* Unfortunately it was spring, and I had for comparison no smutty barley grown in our own fields. But in the following summer, as soon as the smut showed itself in the barley fields, I made cultures from its spores and found that they germinated just like those from Japan. I repeated the experiment with barley smut taken from as many places as possible in the vicinity of Münster in Wesen, but the spores always germinated without conidia. I communicated this observation to my distinguished friend and patron, Prof. Julius Kühn, of Halle, and requested from him some spikes of wheat containing fresh smut. In these also was the same fungus as in the barley, the spores produced no conidia. *According to this the smut fungus on barley and wheat is not the same as that on oats.* In spite of the similar spore form a great difference between the two is shown in the germination of the spores in nutrient solutions.

The negative results of barley infections, and the endeavor to give a natural explanation, led to a further positive result, the discovery of a new form of smut, which, in spite of its universal distribution, had remained unknown, and for the recognition of which it was first necessary to find out, by means of the artificial culture of smut fungi, a new method of diagnosis. I call the new fungus, which occurs on the Hordeæ, *Ustilago hordei.* The consonant behavior of the fungus from Japan and from Germany is evidence at once of its specific peculiarity and its value as a member of the genus *Ustilago.**

*A varying behavior during spore germination in water, sometimes with and again without conidia, was known long ago for the dusty smut, but owing to the rudimentary germination of the spores in water was not followed further. Moreover, seven years

B. For the infection experiments with millet smut, *Ustilago cruenta*, I selected the largest kind of millet, viz, *Sorghum saccharatum* (*nigrum*), because in the others the seedlings are entirely too small and therefore not suited for the experiments. Even the seedlings of the sugar millet are quite small in comparison with those of our own cereals. They have, on the other hand, the advantage that at first they grow much more slowly than the seedlings of oats and barley.

The millet smut (*Hirsebrand*), like the dusty smut, appears in the fruiting spikelets, and the grains are changed into a black mass of smut.* The spores germinate readily and produce sprout conidia in endless abundance. These are deposited in the nutrient solution as a precipitate, which differs strikingly from that of the dusty smut in its whiter color and the non-gelatinizing membrane of the conidia.

I. The first series of experiments, in 1885, was reduced to 32 plants by a hail storm. The germinating embryos were infected with the sprout conidia of *U. cruenta* by means of the atomizer. Among the 32 plants which remained there were, in autumn, 12 smutty and 20 sound.

II. The next series of experiments was made in the following year by direct infection of seedlings, which, however, were not all of the same size or in quite the same stage of germination. In autumn the harvest of 270 plants yielded 120 sound and 150 smutty.

Early experiments, with sufficient materials, where the seedlings were rigorously sorted according to their size, were not begun till 1887.

III. First, the smallest plants, in which the growing point was just emerging from the grain, were picked out and infected. Here, in autumn, out of 250 plants were harvested 180 smutty and 70 sound.†

IV. Next, seedlings were selected with shoots a centimetre long. Here, in autumn, from 150 infected plants were gathered only 24 smutty and 126 sound.

V. Seedlings with shoots 1½ centimetres long. Here, in autumn, from 190 infected plants, 12 diseased panicles were counted; 178 remained sound.

VI. Seedlings with shoots 2 centimetres long and projecting from the sheath. In autumn, out of 220 plants only 4 were diseased, the rest were sound.

VII. Seedlings with shoots which had grown through the sheath to a distance of 1 centimetre. Here, in autumn, *no smutty plants* appeared.

VIII. As soon as the millet seedlings were large enough to be infected by spraying the germs into the heart from above, 192 plants,

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ago, in my first culture experiments with the dusty smut, I discovered that the smut spores from barley would not germinate even after one year, while those from oats still germinated readily after more than six years.

* In more than three hundred smutted millet plants, for which I have to thank Prof. Julius Kühn, I found the smut nowhere except in the ovaries.

† There can be no doubt that the larger per cent of smutty plants in the millet as compared with oats, is referable to the slower growth of the millet seedlings. Otherwise, on account of their smallness, the seedlings are less favorable objects for infection than those of oats.

which had reached a size of about 5 to 6 inches, were thus infected. Where the germs touched, a local sickening was visible after 4 to 6 days. This took the form of a yellowing and subsequent shriveling of the leaves. These were covered with penetration spots, and penetrated in all parts by richly branched fungous threads. The leaves died, but neither completely nor with the formation of smut in their interior. As soon as the plants were compensated by new sound leaves from the bud, they appeared healthy again; but were, of course, somewhat delayed in their development in proportion to the disturbance. Moreover, this whole series of plants proved sound, and brought forth healthy panicles.

IX. An additional 210 millet plants, about a a foot high, were infected in the heart from above. Here the effect was still more remarkable. The young leaves which had been touched and attacked, shriveled considerably after a week, the heart of the plant became very pale, and the mycelium grew luxuriantly through all the attacked leaves. Nevertheless, even here, the diseased leaves were subsequently replaced by sound ones, and aside from the delay in development the plants suffered no injury. The subsequent harvest yielded only sound panicles.

X. Again, 120 plants, 1½ to 2 feet high, were infected in the same way. The symptoms on the attacked leaves grew worse in proportion to the increased size of the vegetative point, so that from external appearances it seemed as if the plants would perish; but this did not happen, and again the new leaves were sound. The result in autumn was the same as before, only sound plants.

The panicle can not be reached by infection from above in millet any more than in oats. It is securely inclosed by the leaves of the bud, and subsequently pushes out sidewise from these. For this reason, additional infections, when the plants were 3 to 4 feet high, had a purely negative result. The young leaves were luxuriantly traversed by the penetrated germs, but the panicles remained uninjured.

The final result of the experiments with millet smut on the sugar millet [sorghum] points to the following conclusions: The plants can be infected with the smut germs in all young undeveloped parts; but only those smut germs which have penetrated into the *nascent* shoot, and have thus reached the growing point, actually produce smut in the panicles, which is its exclusive location. These fungous germs, which have penetrated the host plant in the first stage of germination, remain, as in oats, latent in the plants till their sexual maturity, and then only do they come to maturity in the young ovaries, and to the production of smut beds, which is equivalent to the destruction of the ovaries or of the panicle.

It is worthy of remark that we can not discover the least sign of disease in the plants which bear the destructive germ concealed in their growing points; that, on the contrary, they appear even more luxuriant than the others; and furthermore, that the smutty panicles appear much sooner than the sound ones. For example, in the third series of experiments. 102 smutty panicles had developed up to September 3,

but yet no sound ones. I fully believed that all of the plants would be smutty, until on September 10, the first sound panicle appeared. On October 1 were counted 30 sound panicles and 140 smutty ones; and finally, on October 15, the proportion was 180 diseased, smutty plants to 70 sound ones. In plants which conceal the germ of destruction we find slight traces of the fungous threads only in the nodes and in the growing points, and in the latter they do not attain further development until the ovaries are formed. They then proceed to the formation of spores in this place only, not in the leaves, where they remain sterile and do not produce a single smut spore. The ovaries swell mightily with the rapid and abundant development of the fungus in them, and finally, like the horns of ergot, grow to be many times their natural size, projecting far out of the panicles. Finally, after the complete spore formation of the fungus, they break up and allow the spores to dust away. In this stage scarcely a trace of the mycelium of the fungus is to be found in the host plant.

The behavior of corn smut is directly opposed to that of the smut forms which inhabit the grain exclusively. This form can produce its smut beds on any part of the host plant, and in the strange and repulsive similitude of cancriform swellings and ulcers.

For infection experiments with smut germs the big corn plant is an ideal object. All parts of the maize, from the seedling to the inflorescences and fruit-spikes, are developed on a large scale, and are easily accessible for each form of the experiment. The corn smut itself, *Ustilago maydis*, is also a smut form especially suitable for the infection.

C. I began infection experiments with corn smut in the spring of 1885. The spores of *Ustilago maydis* do not germinate in water, or do so very sparsely only after some years. In nutrient solutions they germinate without exception and immediately. They are therefore consigned to nutrient solutions or nutrient substrata, and not to mere water, for full germination. They produce an endless quantity of sprout conidia, and still more rapidly than the two forms of Ustilago previously mentioned, *U. carbo* and *U. cruenta*. The conidia are thrown down as a white, granulous precipitate, which appears even whiter than the sediment of *Ustilago cruenta*. But in this case the sprouting of the conidia takes place *upon* the nutrient solution, where mold-like pellicles are formed, from which the conidia can easily dust off through the air.*

I. In the first series of experiments, in 1885, I infected only young seedlings in different stages of germination. In more than ten distinct sets of experiments the seedlings were copiously sprayed with conidia and were afterwards set out in the field.

After 16 days, very scattering signs of smut were visible among the plants which had been infected in the earliest stage of germination. Below, upon the axes, a smut swelling was developed, in consequence

* This formation of sprout conidia in the air is likewise peculiar to a number of other *Ustilagineæ e. g.*, *Ustilago bromivora* and *Ustilago destruens*, also *Tolyposporium* etc.

of which the plants died. The loss, however, was trifling, amounting to only 4 or 5 per cent. The seedlings which were infected in later stages gave only 1 or 2 per cent of loss. The last set, with open sheath, remained sound.

The few plants which became diseased so early, and which died completely, suggested in their appearance the smutted maize seedlings which Kühn observed and described. The time of the appearance of the smut swellings after the infection also agreed with Kühn's statement.

I now waited, expecting that, as had happened with oat and millet smut, the corn smut would appear upon the fully developed plant, especially in the fertile spikes, but I waited in vain. Already, the fact that, from this time on, the strongly developing axes remained entirely sound had made me suspicious, and when autumn came, and the ears were formed, *not one out of many hundred plants was smutty.*

Before the issue of this experiment, which had consumed several months, I stood at first helpless. The infections were made as carefully as possible, and the failure was not to be explained by these. This must have other causes. All reflections in the course of the winter led me back to this conclusion, *that probably in maize the infection of young seedlings could not lead to the production of smut in the full-grown plant*, as is the case in smut forms living in the grain. At the time of this first series of experiments, in the year 1885, I still held to the old view, universally current until now, that smut germs generally could penetrate only into the young seedlings in order to appear later as smut beds in the full-grown plant, and that, consequently, a penetration of the germ into the plant when it had passed the seedling stage was not possible. I had not then tried infections in the heart of full-grown plants. In the failure of the infections with the corn seedlings I first found the suggestion for the latter. Gradually I came to the conviction that the view that the fungous germ could penetrate only into the seedling was an embarrassing one; that the seedling consisted only of the young parts of plants, and that, of course, the penetration must occur not exclusively in the seedling but also in all places which were in a young condition similar to the seedling. This applied, first of all, to the growing points, the buds, the heart of the plant which was still growing and forming new tissues overhead. Here, therefore, the infections must be made. These I now prepared for by sowing kernels of corn in long beds, in the open air, at the end of April of the following year (1886).

II. In the first half of June, 1886, the maize plants of a long bed were abundantly infected in the heart by means of a suitable spraying flask. For the most part these plants were about a foot high, and the young leaves of the growing point had formed cornets very suitable for receiving the infection. The plants remained uncovered, as a period of dry weather had set in. The injected fluid containing the sprout germs, which at first covered the growing point, was not to be seen on the following days. The leaves of the tip continued to develop during the

next 10 days normally and luxuriantly. On the twelfth there appeared an etiolation in the heart of the plant, which extended upward as far a the leaves had previously been touched by the injected fluid. In the blanching leaves, the surface of which was strewn with penetration spots, there was an abundant production of mycelium, which had penetrated in all directions. In addition, the commencing hypertrophy of tissue was already clearly visible in the attacked and ever-paler appearing parts. After an additional week, in which the growth of the whole plant, including the parts attacked, had proceeded considerably, the cancroid swellings of the smut pustules reached full development and a size never before seen. The entire leaves were covered with a complete crust of pustule, which in part made them almost unrecognizable; out of all parts of the axis, in fantastic forms like ulcers, the great smut swellings grew luxuriantly, so that the plants in their entirety were deformed and spoiled—a complete picture of disease. Scarcely had the rapidly developed swellings reached full size when they lost their white appearance through internal change of color. The spore formation quickly included the whole densely interwoven mycelial skein inside of the swelling, and the final result was a black mass of smut spores inclosed by the external tissue layers of the host plant, *e. g.*, of the pustule.*

Of all the plants which were infected, *i. e.*, more than a hundred, none remained sound after 4 weeks. The smaller they were at the time of infection, the more they suffered. The extension of the young axis, which was disturbed by the formation of smut and the accompanying hypertrophy of tissue, was afterward completed. Whole plants were wasted and distorted by the fungus into miserable objects. They lay in part upon the earth and perished without exception. On the larger plants the formation of pustules was localized upon the upper parts, the only ones attacked. The lower sound leaves continued to nourish the plants and they did not die. In only twelve of these plants did the injected fluid reach as far as, or penetrate into, the nascent staminate inflorescence. To the extent that this happened the parts soon became smutty, sometimes the tips only, and again the lower portions. The glumes and the filaments swelled more than fifty-fold, and in isolated cases became tumors which, by their weight, afterwards bent down the whole panicle. The long series of charts which I have hung up, and which were drawn by my young friend and associate, Dr. Istvanffi, of Klausenburg, will serve to illustrate the most striking cases from these series of experiments.† In the upper part of one of the pictures, in the

* Through this pathological picture of the cancerous tumors on the maize plant we arrive involuntarily at the notion of what the symptoms would be if the smut spores were not black, and were not produced in such masses as happen in the maize, and if the substratum were not a vegetable, but an animal organism.

† These charts, and many others illustrating the life history of smuts, may be found in Dr. Brefeld's *Heften* V and X, to which he desires me to call attention. These are published by Arthur Felix, Leipsic, Germany. Part X, giving *in extenso* the results here summarized, is now passing through the press.—TR.

attacked staminate inflorescence, there are a number of fertile blossoms the individual ovaries of which reached the size of a walnut, and were still crowned with the base of the style.

On such plants as survived, the appearances of disease diminished after 6 weeks, with the ripening of spores in the pustules, and not long after only the dried pustules remained; aside from these, and the persistent distortions of the upper part of the axis, nothing more was to be seen of the smut. During this time the fertile inflorescences appeared below on the axis, in the axils of the leaves which had remained sound. No smut was to be seen on these, and later they were pollenized from the staminate inflorescences which had remained sound and developed normally. In autumn, a large number of ears bearing sound, ripe kernels were harvested from these plants.

After this conclusion of the series of experiments no doubt could remain that the smut germs develop, and within 14 days, too, in the particular spots of the young parts of the plants into which they have penetrated, and in these only. All parts of the plants which are not touched directly by the germs remain sound, so that sound ears can be gathered in autumn from maize plants which are infected in the heart in summer and which become smutty on all parts that have been touched directly.

But here was still necessary the additional experiment of verification by which it must actually be proved that the fertile inflorescences also become smutty as soon as they come into direct contact with smut germs while still in a very young condition.

III. Again, the next year I had whole beds of maize plants prepared in the field for supplemental infections. I waited for the time when the pistillate inflorescences should begin to appear on the sound plants. These showed distinctly at the end of July, on the third to fifth internodes of the axis, by a swelling of the leaf sheath. As soon as the swelling had reached the point where the otherwise firmly encompassing ligule was pushed up somewhat from the axis, the infection was made by spraying into the leaf sheath so that the injected fluid containing the sprout germs stood even with the rim of the ligule. More than one hundred plants, each of which, as a rule, afterward brought forth two ears, were infected in this way.

The results of the infection were visible at the expiration of 14 days. The leaf sheaths were burst open, and the ears within came to view as a continuous smut pustule. Individual ears swelled to the size of a child's head, and only here and there distinguishable were the peculiarities of the fertile inflorescence, the ovaries of the young ear; otherwise, for the most part, was to be seen a single deformed, repulsive structure. No fertile inflorescence, which was infected when a young bud, remained uninjured. The narrowly local action of the infection could be shown directly on the plants on which the lowest flower buds were infected but not the upper. The latter always remained sound; the former alone were destroyed.

IV. The formation of the pustules in the very young ear did not yet exactly correspond to the appearances which I had formerly seen on fertile spikes, where each ovary had swollen individually into a tumor as big as a nut, so I extended the experiments still further. Ears which already bore silks were somewhat opened at the tip, and only the exposed ovaries of the spike were infected by means of the sprayer, while the lower were not infected. If the presumption as to the narrowly local action of the infection were correct, then in this case also only the upper ovaries would become smutty.

The ovaries behaved with military punctuality. After 16 days the upper ones swelled, and became almost egg-sized smut tumors, as the suspended pictures show. All of the ovaries lower down on the same spike yielded sound, normal grains.

V. There remained only the incipient adventive roots on the lower nodes of the axis as susceptible objects of attack. The beginnings first appear when the growing points and the leaves have reached full size, *i. e.*, when the plants begin to elongate. They appear in a r.ng around the nodes near the ground; the farther up they are the shorter they remain, and then, generally, they do not penetrate into the earth.

As soon as the tips of the roots were exposed, the infections were made by spraying with the atomizer, and then a shelter from rain was placed over the roots. Once more, after 3 weeks, individual root tips showed swellings of the bigness of a nut on their ends, which meanwhile had elongated. These swellings developed into normal smut pustules, as shown in this sketch.

VI. To round out the experiments, the silks which hung far out of the fertile inflorescences were also infected by spraying. Here the infection had no result, as was to be expected. The silks remained unchanged, and their spikes, which were protected from the infection, also remained entirely sound. The silks, indeed, are no longer young tissue. The fungous germs still penetrate occasionally, but do not develop, because the luxuriant growth of tissues necessary for the formation of pustules is excluded.

VII. All infection experiments made by spraying into the heart of the plant when the sterile inflorescences were already visible in the growing points, were also without results. Penetration spots were still to be found, and also fungous threads in the superficial tissues. Externally on the leaves a slight shrinking was also observed on isolated spots, but they recovered because the fungous germs found in the already too old tissues no suitable place for the production of smut beds. I have already referred to the fact that penetration itself is impossible in still older parts of the maize plant which have reached nearly full growth.

According to this, the final result of all the infections with corn smut on maize is entirely different from the previously described results with smut fungi living exclusively in the grains. The smut germs come to

all development and produce smut pustules and spore beds on every pot of the still undeveloped parts of the plant into which they have penetrated. The action of the germ is narrowly localized—only those parts of the young plant become smutty which have been attacked directly by the fungous germs; all the rest remain normal and sound. The formation of the smut pustules begins quickly, at longest, 3 weeks after the infection.

The complete result of all the here-cited infection experiments with dusty smut, millet smut, and corn smut affords, in the first place, indisputable proof that the germs of smut fungi which live saprophytically outside of the host plants can produce smut diseases.

When the smut was nourished saprophytically longer than a year in continual reproduction outside of the host plant, then only did the outgrowth of the conidia into germ tubes cease. Along with this the power of infection was extinguished, *i. e.*, with the disappearance of a comprehensible morphological character, for the germs can only penetrate into the host plants by means of their germ tubes.

The earlier view that only young seedlings of the host plants are receptive to the fungous germ has not been sustained. On the contrary, the fungous germs can penetrate into all sufficiently young parts of the host plant.

In the grain-infesting smut fungi, *e. g.*, in the dusty smut and millet smut, of all the fungous germs which have penetrated into the young parts of the plant, of course, only those come to maturity, *i. e.*, to the production of smut diseases, which reach the growing point and the place of the here-included nascent inflorescence. This takes place only in the germs which have penetrated into the young seedling in the vicinity of the root nodes during the first stage of germination. For all the other germs which have penetrated later this is already impossible. The vegetative tips with their incipient blossoms, the later place of development of the smut, have already grown away from these, and consequently are entirely out of reach inside of the plant.

The relative rapidity of germination in plants receptive to smut diseases aids materially in determining the subsequent appearance of the smut, *i. e.*, the development of the germ which has penetrated. This may vary according to the accidental temperature prevailing at the time of germination, therefore according to external influences; but from internal causes it will also be dissimilar in particular individuals, which accordingly may show an individually different receptivity.

In the peculiarities formerly stated, and now clearly established by me, the natural explanation is given, so far as regards smut diseases, to the terms "periodic receptivity," "subsequent immunity," and "individual predisposition to an infective disease."

Especially noteworthy is the long incubation period from the penetration of the fungous germ to the outbreak of the disease. The germ of the destructive disease is taken up in the earliest youth of the plant

and first comes to destructive action when the latter is sexually mature. Here we have a case of "definite periodicity in an infectious disease" explained clearly and naturally by actual peculiarities. The disease germs remain latent, and traces even are scarcely to be found. The attacked individuals are even stimulated in their growth, and are in advance of the sound ones—until suddenly at the time of sexual maturity the disease germs, hitherto concealed within, come into destructive operation.

In smut fungi, which do not live exclusively in the grains, but also appear and form smut beds in other parts of the plants, *e. g.*, in corn smut, the infection remains local. The fungous germs proceed to the development of smut in the sufficiently young parts of the plants only on those spots into which they have penetrated. The plants are receptive to the infection as long as young parts are being produced on them. Only when this is no longer the case, *i. e.*, when the plants are full grown, does the stage of immunity begin. To what extent the peculiarities in the smut fungi and smut diseases, which are now explained, may be of value for judgment upon similar occurrences in infectious diseases, especially in pathology, is self-evident.

In conclusion, I may be permitted to observe that seven years' labor was necessary to reach the conclusions on smut fungi and smut diseases given in my first address four years ago, and in this present one. The substance of this address is here made public for the first time as original work.

RIPE ROT OF GRAPES AND APPLES.*

By E. A. Southworth.

Plate XVI.

HISTORY OF THE FUNGUS.

Judging from the bibliography of the fungus of ripe rot and from the very scant specimens in the herbarium, it seems to have received four or five distinct names at the hands of three or more investigators. The fact that it varies greatly in its microscopic and external characters probably accounts for the vicissitudes of nomenclature through which it has passed, and for the fact that one authority has given it two and perhaps three names.

In 1854, M. J. Berkeley described and figured in the Gardeners' Chronicle a disease of the grape caused by a fungus to which he gave the name *Septoria rufo-maculans*. He describes the fungus as attacking ripe fruit and causing considerable destruction. From his figures and general description there is little doubt that the fungus is the same as

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* *Glœosporium fructigenum*, Berk.

the one which is the subject of this paper. Later he changed the name to *Ascochyta rufo-maculans*, and it is described under the latter name in Saccardo's *Sylloge*, although Von Thümen in Fungi Pomicoli calls it *Glœosporium rufo-maculans*.

In 1856, in the same journal, Berkeley described and figured a fungus on apples under the name of *Glœosporium fructigenum*, and said:

It was impossible not to call to mind the little fungus figured upon grapes, * * * and the subjoined figure compared with the one there given would at first seem to indicate an identity. But the spores were more inclined to be curved, rather longer, and not so variable in size, and the want of a perithecium separated the two widely from each other. * * * I would not affirm that the two productions are essentially different, and the more especially because in external appearance and habit they are so perfectly identical.

In the Gardeners' Chronicle for 1859 Mr. Berkeley describes a fungus on peaches and nectarines, *Glœosporium lœticolor*, as new to science. The description is not accompanied by figures, and it varies in some important points from that of the two preceding fungi, but in closing Mr. Berkeley says:

A plant of the same genus destructive to apples is figured and described in this journal. We may also refer to the very similar production on grapes.

As we possess no specimens of *G. lœticolor* it is impossible to draw any conclusion as to whether this is or is not the same as *G. fructigenum*, but it does not seem impossible. The chief points of variation may be accounted for by the change of host.*

Still another fungus, or the same fungus under another name, was described by Berkeley and Curtis from South Carolina in Grevillea, in 1874, as attacking apples. They give it the name *Glœosporium versicolor*, and remark that "it is very different in habit from *G. fructigenum*, which also occurs on apples."

It is to be noted, however, that the specimen from which Berkeley described *G. fructigenum* was kept in the house, and if this was not the case with the fruit from which the other fungus was described there is a wide chance for variation, especially in a fungus which varies greatly even under the same conditions.

The herbarium of the Department gives very little aid in reaching any decision as to the identity of these fungi. There is one specimen labeled *G. fructigenum*, from Newfield, New Jersey, on rotting pears, but I am not sure as to the authority for its identification; and another of *G. versicolor*, from Delaware, which was distributed in Ellis and Everhart's North American Fungi, No. 1897, on apples. From a comparison of the two specimens there seems to be no doubt that they represent the same fungus. Of course it is impossible to form a decision which would be of any value from these premises, but it is evident that the

* W. G. Smith has recently figured a fungus on grapes which he calls *G. lœticolor*, and which from the figures seems to be the same as the *G. fructigenum* of this article.

descriptions given, if they do represent different fungi, are not sufficiently accurate to give us any criterion of identification.

In the Annual Report for 1888 Mr. Galloway described a fungus causing the bitter rot of apples, which he identified as Berkeley's fungus *Glœosporium fructigenum*, and which agreed closely with the herbarium specimens.

In the summer of 1888 Prof. F. L. Scribner found what he supposed to be a new fungus on the grape in the Department grounds. He examined it, but as its similarity to bitter rot of grapes threw some doubt on its specific value no further observations in regard to it were made. In the following season it was found again by the writer, and since then it has come to the Department from several sources.

A study of its structure at once suggested a close relationship with the fungus causing bitter rot of apples, and also with the one causing the bitter rot of grapes. It differs from the latter, however, in several points.

Owing to its similarity of form with bitter rot of the apple, a series of experiments was undertaken to ascertain whether or not the two were identical. Living spores of the grape fungus were inserted under the skin of healthy apples by means of a flamed knife, and other apples similarly punctured but not having the spores inserted were used as checks. At least twelve apples were thus infected, each apple being infected at three points. In every case but one the fungus developed, and with but one exception at all of the infected points. The one exception was where spores were used which a few days later were found to be incapable of germination. In case of another apple, spores were purposely used which were supposed to be past the power of germination. The result was that the fungus developed at one point of infection only, and this was probably the result of carelessness, as the knife was not flamed after being used to infect an apple with spores from another grape, and the spot into which the knife was first pushed received some of these spores that were capable of germination. None of the checks developed the fungus. The rot spots began to appear in about 3 days, and pustules made their appearance in from 5 to 8 days.

Apples attacked by the typical bitter rot fungus were obtained from Arkansas, and the spores were used for infecting grapes in a manner similar to that described for apples.

The results were not so striking as in the former case, but in a small proportion of the infected grapes typical pustules with spores were developed, and this was not true of the checks. Many of the infected grapes, which did not show pustules, decayed in a manner typical of grapes attacked by the fungus, but grapes were so much harder than apples to preserve from the attacks of saprophytic fungi that in most cases they succumbed to these before the *Glœosporium* had a chance to complete its development. The most successful infection experiments

were made on Malaga grapes, three or four berries out of a dozen developing the fungus, but grapes grown on the grounds were also successfully infected.

The pustules produced by inoculation were exactly like those produced in a state of nature, and the fungus in apples infected with spores from another apple was exactly the same, both as to structure and effects produced, as in apples infected with spores taken from the grape.

These experiments leave no doubt that the fungus found here on the grape is the same as the bitter rot of apples. And from a comparison of Berkeley's figures and description there is very little doubt that it is identical with his *Ascochyta* (*Septoria*) *rufo-maculans*. The strict law of priority might demand that we now make the specific name *rufo-maculans*, but since the better known *G. fructigenum* is also Berkeley's name it will remain so in this paper. It is perhaps well to say that Professor Cavara has kindly compared this fungus with the *Tubercularia acinorum* described by himself and states that the two are distinct.

The proper settlement of the whole question depends upon the comparison of type specimens not accessible to us, and it is hoped in what follows to give a sufficiently full description of the fungus so that others who have these specimens within reach may be able, by comparing them with the figures and descriptions, to decide whether they represent distinct species or not.

The popular name which should be given to the disease on both grapes and apples is nearly as much of a question as that of the scientific name of the fungus. The old term, bitter-rot, so applicable to the disease of the apple, will not do for the grape, as the fungus does not give the latter fruit any bitter taste, and the name is already given to another grape-rot, caused by a fungus, which does impart a decided bitterness to the ripe berry. The term anthracnose is also preëmpted, otherwise that might be used, as this fungus belongs to the same type as others causing this disease. The name ripe rot, which has been finally adopted, may answer the purpose in spite of its lack of euphony, as the fungus attacks neither grapes nor apples until they begin to ripen.

EXTERNAL CHARACTERS.*

On the apple.—The presence of the fungus is first indicated by one or more brown spots somewhere on the surface of the apple. These may not be more than a quarter of an inch across at first, but they spread very rapidly and in time cover the whole apple. The spots have the appearance of ordinary decay except that they are a little sunken, and are apt to be somewhat firmer than is natural where this fungus is not present. Moreover, after the spot has existed a few days, small black pustules make their appearance on the surface. These are often so numerous in the center as to give it a black color, and those nearer

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*Colored drawings of the external effects of this fungus will appear in the Annual Report for 1890.

the circumference are likely to be arranged in circles. It not infrequently happens that the pustules are not black at first, especially when the apples have been kept in a moist environment. They may appear quite white before they break through the cuticle, and later the spore masses give them a pink color over the top. Sections through diseased apples show that the tissues are decaying for some distance; and in preparing a partly decayed fruit for eating, great care must be taken to remove every fragment of this discolored tissue, as a scarcely perceptible amount can impart an intensely bitter taste.

On the grape.—The fungus seems to attack only ripe grapes, and when the diseased grape is a purple one no change of color occurs, but the berry decays and the skin seems to be raised up in pustules over the diseased portions. On white grapes the fungus produces a very characteristic appearance. A small, reddish-brown spot appears on the side of the berry; this spreads and becomes darker in the center, so that by the time it has spread over half the berry it has a purplish center merging into a narrow bright-brown border. It is moreover covered with minute pustules which are at first whitish, then exude a flesh-colored powder, and finally become dark brown or even black with age. The berry finally becomes quite dry and shriveled, but even in this condition it does not become black like those attacked by black rot, but may even preserve a translucent appearance. On a few grapes, whose tissues were at the same time hardened by the presence of the mycelium of *Peronospora viticola*, the areas attacked by the *Glœosporium* had sunken in, as is the case with the apple. On the grape the pustules often continue bearing spores, and hence retain their flesh-colored appearance even when the berry is nearly all dried up. The fungus does not communicate a bitter taste to this fruit.

MICROSCOPIC CHARACTERS.

The structure of the fungus is so variable that it is almost impossible to frame a description that will be true under all circumstances.

The appearance of the fruiting bodies differs on nearly every berry that the fungus attacks, although it is a somewhat curious fact that the pustules on any one berry are very nearly alike. The color and shape of the spores are the most constant characters, but the latter varies considerably. In the following description the most characteristic and common variations will be noted, but they by no means comprise all that may be expected even in a short study of the fungus.

The first stage in the formation of the fruiting body is the most constant one. A cushion of stroma forms just below the upper wall in a group of the epidermal cells; as it increases in size the contents and lower wall are pushed downwards, the cross walls are broken or absorbed, and the upper wall pushed upward until it is ruptured and the fungus exposed to the air. As soon as the stroma has attained about 20μ in thickness it can be seen to consist of parallel threads arranged at right angles to

the plane of the epidermis, and containing frequent septa. The stroma mass is colorless at first and shaped like a double convex lens. The hyphæ composing it are adherent along their whole course and may branch. The central portion is often composed of larger, more transparent hyphæ. When the cuticle is finally ruptured the shape of the stroma may change considerably, from the fact that it meets no further resistance to its upward growth. It is also from this time on that the changes which cause the fungus to be so variable take place. Sometimes the free ends of the hyphæ bear spores over the entire surface so that the stroma forms a compound sporophore, but usually the large cells comprising the center of the stroma mass break down, and the entire center becomes separated from the outer portions and may pass out through the opening in the cuticle. In this case spores are borne around the circumference of the stroma and the cavity left in the center develops basidia and spores on its sides, thus producing a pseudo-pcynidium. The amount of the stroma that disappears after the cuticle is ruptured varies exceedingly. In some cases the original mass seems to remain and grow dark colored. In other cases a large amount of stroma still remains, but it becomes dark colored, and enough of the original mass has disappeared so that the spores are borne on a very concave surface. The stroma grows dark colored as soon as the cuticle is ruptured, but the lower part of the central portion usually remains colorless except in very old pustules. In some of these, especially on the apple, it looks as if the stroma had greatly increased in quantity and in a measure at least lost its spore-bearing property. Whether this apparent increase is due to a growth from the base of the stroma has not been directly observed, but from the appearance of the sections this conclusion is almost irresistible, and the fact that the base often remains colorless below the center supports such a view. Examples of this are frequent on the grape, but on the apple the older dark-colored pustules are especially large and after a time seem to stop forming spores. When kept for a long time in a moist environment the ends of the hyphæ sometimes grow out into long dark-colored filaments.

Besides these more common forms there are cases where the stroma almost completely disappears after the cuticle is ruptured, and the result is a typical Glœsosporium form, viz, rather long basidia borne on a thin stroma and bearing oblong spores at their free ends. Still another case was found where, instead of a true stroma, the hyphæ were independent down to the very thin, irregular layer of pseudo-parenchyma always at the base of the parallel threads; thus forming extraordinarily long basidia with spores at their ends.

Spores.—The spores are unicellular but may become two or even three celled at the time of germination. They are colorless singly but flesh colored in mass, irregularly oblong, sometimes curved and often pointed at one end, or even ovate. They vary greatly in size as well as in shape, and in the case illustrated in Fig. 4 are much longer than

usual. They are apt to be shorter and thicker on the apple, and in dry than in moist surroundings.

Mycelium.—The mycelium is septate and branching, usually colorless, but may become darker colored with age. It is both intra and inter cellular, preferably the latter. In the apple it is sometimes so thick just below the epidermis that it nearly forms a continuous sheet, the threads lying parallel side by side.

The spores begin to germinate in water in about six hours. They swell considerably. The vacuole disappears, but the spore contents pass into the germ tube and the spore is either left partially empty or filled with very thin, slightly refringent protoplasm.

In several germination experiments secondary spores were produced in large numbers. What the conditions were that decided their appearance could not be determined. They were produced both in nutritive media and water, but seemed to be especially numerous where the ends of the hyphæ came in contact with some hard substance like the cover glass, and in two cases the addition of an extra drop of nutritive medium had the effect of stopping their formation. They may be formed on the end of the germ tube when it is no longer than the spore itself, and as the mycelium becomes better developed nearly every branch may produce a secondary spore on its end. They are developed as simple, colorless expansions of the end of the tube, which soon becomes delimited from the rest of the hypha by a septum. The walls become thickened and dark colored, the contents nearly transparent, and a bright spot, strongly refracting, like an oil globule, makes its appearance in the center. The mature spore has a very faint olive tinge and is nearly ovate in outline, being truncate at the smaller end on account of the septum which cuts it off from the hypha. They only retain their original regular form for a short time, the walls soon pushing out in all directions, thus forming a very irregularly lobed body. Sometimes these secondary spores send out a germ tube, and when this happens the bright spot disappears and the spore becomes lighter colored, the contents having apparently been exhausted. More often, however, the mycelium branches just below the point of insertion of the secondary spore, and even in this case the latter sometimes undergoes the changes just described.

The contents of the growing mycelium are at first granular, later becoming more homogenous, and by the time they have reached the stage illustrated in Fig. 7*b* occasional vacuoles make their appearance. Septa are formed soon after germination.

Setæ.—In a few cases brown setæ have been found in the pustules, both on the apple and on the grape, but mostly on the latter. They do not seem to be sufficiently constant or numerous to characterize the species. Where found they are two or more in a pustule, are septate, and of varying length.

Except for the shape and color of the spores this fungus would seem from the description to be identical with that of bitter rot of grapes

(*Melanconium fuliginea*, (S. & V.) Cav.) but there are several points of difference. The spores of bitter rot are navicular and fuliginous, and the stroma is made up of smaller and more uniformly dark-colored cells; moreover it does not seem to be as variable as that of the ripe rot, but there is a more regular disappearance of the upper central portion of the stroma, leaving a cavity the sides of which are always lined with spores and basidia. The formation of secondary spores has never been observed for the Melanconium and the mycelium proceeding from the spore is very different from that of the Glœosporium and is fuliginous. It does seem, however, as if the two fungi ought to be placed in the same genus, but it is not the purpose of this paper to make any changes in nomenclature.

Later stages.—In the Annual Report for 1887 Mr. Galloway described a stage which seemed to be an immature pycnidium. In hopes of obtaining more definite results in this direction, a number of apples which showed numerous characteristic pustules were placed under bell jars in the fall and left until midwinter. When examined, the stages figured in the annual report were found; but in some cases the fruiting body was composed of one outer layer of dark-colored cells, those inside being colorless, and the contents of the central ones broken up into small particles. The structure of the entire body closely resembled that of the immature pycnidia of black rot of grapes, the colorless cells being isodiametric and nearly hexagonal. No spores could be seen, but in one or two cases the contents of the conceptacle were not fully distinguishable, and seemed to be partly composed of radiating lines passing from the circumference to the center. From the top of these bodies arose the characteristic stroma mass, or rather, in this case, a compound sporophore, bearing spores at the free ends of the hyphæ. Still later, one conceptacle showed two asci containing partly developed spores. Unfortunately, the apples were so overgrown with Penicillium and so putrid from the attacks of insect larvæ and bacteria that they had to be thrown away before any more definite results could be obtained.

ECONOMIC NOTES.

The fungus has been known on the apple for a long time, Berkeley's first description of it dating back to 1856. During the past five years it has proved very destructive in certain localities especially in the South and Southwest. One fruit grower from Arkansas reported that from the effects of the rot in the summer of 1887 his orchard of seventy-five trees would not yield 25 bushels. Until the present season only solitary cases have been known of the fungus attacking the grapes, but during the past summer we have received specimens from Connecticut and New York. In the latter State it was observed in Wayne, Cayuga, and Seneca Counties and was found on grapes sent in from the grape-growing district in the southeastern part of the State. It seems to be slowly spreading on the grape, and attacks the fruit often after it is

stored in crates preparatory to sorting. It seems to spread in these large crates, and was found in the most active stage as forming a large per cent of the cullings from the packers.*

Thus far it has been by no means a serious enemy to the grape, but the chief danger for the future seems to lie in the fact that it has proved so formidable on the apple and that the grape can not be considered as safe from its attacks if apples in the vicinity are diseased.

It attacks neither fruit until the ripening process has begun, and with the apple as with the grape may develop and spread after they are packed and stored.

Treatment.—From the foregoing it is evident that it is of great importance to carefully cull all fruit among which the presence of the disease is suspected, as a diseased fruit may infect the healthy ones that lie in contact with it. It has been shown, however, by one experiment, that this disease can be almost wholly avoided by the use of fungicides.

In the summer of 1888 the Department commissioned Mr. Geo. Curtiss, of Stafford County, Virginia, to make a trial of certain fungicides in the prevention of the disease. Mr. Curtiss had repeatedly lost all of certain varieties by this fungus, and his orchard offered a good field for experiment. In order to make the value of the remedies used perfectly clear he left some of the trees unsprayed, and in one case he sprayed only half of a tree, leaving the other half unsprayed as a check. The remedies used were potassium sulphide (one-half ounce to a gallon of water) and the ammoniacal copper carbonate. The sprayings were not begun until August 18 for the potassium sulphide, and August 27 for the copper carbonate, too late in both cases for the best results, as the disease had already made considerable progress. But even under these unfavorable conditions the result was very marked. The apples that were not diseased at the time of spraying were perfectly protected, while the unsprayed trees dropped all their fruit. On the tree that was half sprayed the difference between the two sides was as marked as between the sprayed and unsprayed trees. If the spraying had been done a month earlier it is reasonable to suppose that with proper care in application the rot could have been almost entirely prevented.

Where copper remedies are used for black rot or mildew it is not likely that the grapes are in danger from the ripe rot, and in cases where no remedies have been used, two or three sprayings will probably protect the grapes. For this it will not be necessary to go to the expense of preparing the Bordeaux mixture, but the ammoniacal solution or even the potassium sulphide will probably be satisfactory.

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* See Diseases of the Grape in Western New York. Journal. Vol. VI, No. 3, p. 99. Referred to as the Grape glœosporium.

SOUTHWORTH ON RIPE ROT OF GRAPES AND APPLES.

BIBLIOGRAPHY.

Berkeley, M. J. *Septoria rufo-maculans.* Gardeners' Chronicle, 1854, p. 676.

———. *Ascochyta rufo-maculans.* Outlines of British Fungology, 1860, p. 320.

———. *Glœosporium fructigenum.* Gardeners' Chronicle, 1856, p. 245.

———. *Glœosporium lœticolor.* Gardeners' Chronicle, 1859, p. 604.

——— and Curtis, M. A. *Glœosporium versicolor.* Grevillea, Vol. III, p. 13.

Curtiss, G. C. *Treatment of bitter rot of apple.* Section of Vegetable Pathology, U. S. Department of Agriculture, Bulletin 11, p. 38.

Ellis, J. B., and Everhart, B. M. *Glœosporium versicolor*, B. and C. Journal of Mycology, Vol. I, p. 112.

Galloway, B. T. *Bitter rot of the apple.* Annual Report U. S. Department of Agriculture, 1887, p. 248.

———. *Sulphuret of potassium for bitter rot of apples.* Journal of Mycology, Vol. V, p. 37.

———. *Bitter rot of apples.* Section of Vegetable Pathology, U. S. Department of Agriculture, Bulletin 8, p. 61.

———. *Bitter rot of the apple.* Annual Report U. S. Department of Agriculture, 1889, p. 412.

Saccardo, P. A. *Ascochyta rufo-maculans*, Berk. Sylloge, Vol. III, p. 395.

———. *Glœosporium fructigenum*, Berk. Sylloge, Vol. III, p. 718.

———. *Glœosporium lœticolor*, Berk. Sylloge, Vol. III, p. 718.

———. *Glœosporium versicolor*, B. and C. Sylloge, Vol. III, p. 718.

Smith, W. G. *Glœosporium lœticolor*, Berk. Gardeners' Chronicle, 1890, p. 657.

Von Thümen, F. *Glœosoporium rufo-maculans* (Berk.), Thum. Fungi Pomicoli, p. 59.

———. *Glœosporium versicolor*, B. and C. Fungi Pomicoli, p. 60.

———. *Glœosporium lœticolor*, Berk. Die Pilze des Aprikosenbaumes, p. 6.

DESCRIPTION OF PLATE.

FIG. 1. Stroma mass broken through the epidermis. Drawn from specimen, soaked in potash, which caused the ends of the hyphæ to swell and the spores, if there were any, to fall off.

FIG. 2. A later stage. The central part of the stroma mass has begun to break down and spores to form around the circumference.

FIG. 3. Still later stage in the same process.

FIG. 4. Glœosporium form of fungus.

FIG. 5. Spores; three on basidia.

FIG. 6. Setæ.

FIG. 7. Germinating spores; some producing secondary spores on hyphæ.

ANTHRACNOSE OF COTTON.*

PLATES XVII, XVIII.

By GEORGE F. ATKINSON.

While investigating the disease of cotton popularly called "black rust" and "red rust," I found upon an old leaf scar of a cotton stalk a fungus, the spores of which in mass are of a roseate tint. The spores were produced in small clustered heaps, which at length broke through

* Paper read before the American Association of Agricultural Colleges and Experiment Stations. Champaign, Ill., November 11–13, 1890.

to the surface. The fungus resembled very closely members of the genus *Glœosporium*. Farther investigation showed that older specimens possessed olive or dark-brown setæ, intermingled with the colorless basidia. The setæ are proportionately few where the substratum is soft, more numerous when it becomes hard or in the dead or nearly dried parts of the plant, particularly on the stems and the dissepiments of the open boll. The presence of setæ shows the affinity of the fungus with the genus *Colletotrichum*.

On the green bolls the fungus produces depressed spots, at first of a black color, caused by the death of the tissues. If the weather is favorable for the development of numerous spores the dark depressions later assume a grayish or roseate tint from the lesser or greater mass of spores developed. Sometimes the depressions are not well marked, but the fungus being evenly distributed gives a black color to a large portion of the surface of the boll. A severe attack seems to hasten a premature partial opening of the boll, but frequently this checks the growth and the lint can not escape. In such cases the fungus frequently grows also on the lint. Besides these characteristic effects on the boll, the fungus severely injures other parts of the plant. It is a very common accompaniment of *Cercospora gossypina*, Cooke, and other fungi of "black rust" on the leaves, and does much to aggravate that disease. So early as August 12 I found it upon the leaves, and it probably occurred earlier.

The *Colletotrichum* also occasions a very distinct and destructive disease of the cotton plant. A remarkable example of this occurred on the Station farm in some cotton planted in "checks," *i. e.*, in hills with the rows running both ways. The portion of the field attacked was about 2 or 3 acres in extent. During August I noted on my weekly visits that the usual fungi of "black rust" and "red rust" were present, but not sufficient in extent to do any appreciable injury nor to characterize these diseases as they are known to the farmers of Alabama. I found also the *Colletotrichum* principally on the edges of the leaves. In September the *Colletotrichum* severely attacked the stems of the upper part of the plant. The leaves soon appeared, as some expressed it, as if they were affected with a "scald," changing to various shades of yellowish or leaden green color. They soon withered and dried much as if killed by frost, presenting a decidedly different appearance from leaves killed by black rust. The stems became blackened and the death of the plant usually followed.

I have observed the same characteristic disease in several localities around Auburn, but this patch of 2 or 3 acres is the largest I have met with. It is not improbable that in some of the cases reported as "black rust," where in the first stages of the disease it sweeps rapidly and suddenly over certain spots, the *Colletotrichum* is the ultimate factor in causing the death of the plant, and then frequently continues the disease upon the bolls.

Characters of the fungus.—The spores are oblong, usually rather sharply pointed at the base, often rounded at both ends, with a broad shallow constriction in the middle, nearly cylindrical or distinctly curved, sometimes "binucleate." They vary greatly in size from 4.5 to 9μ in diameter by 15 to 20μ in length. Where they are produced on green or decaying bolls, or other softened parts of the plant the distinct acervuli are 100 to 150μ in diameter. On the leaves the acervuli are much smaller and very rarely in sufficient quantity to give the roseate tint. I have found one case of the fungus on a cotyledon of a young plant where the color was distinctly produced. The cotyledons, however, are much more succulent than the leaves. It had also been raining for several days, so that the diseased part could not dry and thus check the profuse development of spores. Many of the spores are borne on scattered fertile hyphæ within the tissues of the leaf, not being collected into distinct clusters. As the tissues of the plant become harder by the partial drying of the leaf the spores produced are fewer in number and borne mainly upon the ends of the setæ.

The setæ are olive or dark brown, straight, curved, flexuous, or rarely branched. They arise from especial bodies, resembling somewhat an imperfect sclerotium, composed of a single dark-brown cell or of a varying number of dark-brown cells, generally a few. When of several cells it is irregular in shape. It is situated within the tissues of the host or projects slightly above the surface or lies along between the cells of the epidermis. When the body consists of a single cell it is produced at the end of a hypha, but is greater in diameter. These single cells may increase to the several-celled sclerotia by a process of growth similar to budding, except that the cells thus formed remain in a closely compact body. The end cells of the setæ are nearly hyaline. The spores borne upon them are often oval, the base being rather sharply pointed. The setæ vary in length from 100 to 250μ. They are usually decidedly shorter on the leaves than on the other parts of the plant. They are in clusters of 5 to 10, or more. Frequently the clusters are so numerous as to make it appear that the setæ are evenly distributed over the substratum.

Artificial cultures.—A number of artificial cultures were made to trace the development of the setæ and the peculiar bodies which bear them. The nutrient medium in most cases was agar peptone broth and an infusion of cotton leaves. Pure cultures were obtained by placing bolls on which the spores were just being produced in a moist chamber. When the cluster of spores was well elevated and distinct, not so old as to be contaminated with bacteria, with a flamed needle a few spores could usually be taken not accompanied by other germs.

The cultures were made in cells. The spores germinated quite freely within 12 to 15 hours, possibly much sooner under favorable conditions. At the time of germination, or prior to it, frequently one or two transverse septa are found in the spore, dividing it into two or three cells.

Several germ tubes may be produced from a single spore. The mycelial threads begin to branch immediately and are somewhat flexuous in their course. From all parts of the mycelium short fertile branches soon arose of 1, 2, or 3 cells' length, which resemble the basidia and produce spores. Sometimes these fertile branches or basidia arise directly from the spore. In the solid medium the spores from a single basidium, when not crowded by the basidia and other spores, are clustered around the end. Each succeeding spore pushing the one which has just become free to one side. The sharply pointed basal end of the spore favors this. After several days there is a beautiful crown cluster of spores about the end of the basidium, all lying parallel to each other. Spores are sometimes produced within 24 hours from the time of sowing.

Besides the production of spores, certain of the branches, either near, or remote from, the center of growth, produce at their ends peculiar enlarged cells, olive brown in color, varying in their outline, but always of greater diameter than the hyphæ which produce them. These bodies frequently produce immediately a normal hypha resembling the others of the mycelium. This in turn may soon produce another special cell, or may grow to considerable length, produce basidia and spores, or as a basidium or fertile hypha direct from the special cell produce spores. In other cases the special cell immediately begins to bud in an irregular manner, producing cells similar in color but very closely compacted into an irregular oval or elongated or flattened imperfect sclerotium. After one or two weeks' growth a large number of these special cells and imperfect sclerotia are produced near the center of growth, *i. e.*, original spore. At the same time the basidia have become very numerous at this point, arising from the mycelium or by the branching of the older ones, and the mass of spores assumes the roseate tint. In several cases I have been able to have the production of the dark-brown setæ borne on these special bodies or cells in the artificial cultures.

Cultures were also started in pure water and in a weak nutrient medium. In water the germ tubes, almost invariably, when once or twice the length of the spore, produced the special cell. If these produced another tube it was only to give rise to another cell of the dark color. In no case were spores produced nor any appreciable length of mycelium. In the weak nutrient medium the special cells were produced freely. Also a number of hyphæ produced one to four or five spores. While the vegetative growth exceeded that of the spores sown in pure water, there was but little compared with the growth in a rich nutrient medium, and the spores did not seem to live long.

These special dark-brown cells, produced soon after germination more freely in weak nutrient media, remind one of secondary spores, but the fact that they are produced in rich nutrient media when ordinary spores are abundant, and especially since they grow by an irregular process of budding to cellular bodies resembling sclerotia, and in both cases

produce setæ, seems to favor the notion that they may serve as peculiar resting bodies produced more abundantly in unfavorable conditions, and later capable of producing mycelia again.

I have observed these same peculiar cells preceding the formation of sclerotia, and intermingled with them in the case of *Vermicularia circinans* on the onion. This is additional testimony regarding the close relationship existing between some of the species of *Colletotrichum* and *Vermicularia.*

Parallel with the artificial cultures, inoculations were made of seedlings grown in a frame. A portion of a boll containing a profuse development of spores was immersed in distilled water which was then shaken thoroughly. The cotyledons of the plantlets were well wetted with this. A bell jar was then placed over them for twenty-four hours. An attempt was then made to imitate as nearly as possible the natural conditions of temperature and humidity, which seem to favor the early development for a few days. By artificial heat temperatures ranging from night to midday, 20° to 35° C. were produced. The humidity of the air in the frame was also kept above that of the open air by keeping the frame closed, having but little ventilation and wetting the soil daily. After the fourth day the humidity was reduced while the temperature was maintained. It was not found necessary to inoculate at incisions in parts of the plant.

A week later an examination was made of a cotyledon which was dying, the distal end being half dead and shriveled while the base was still green. It was well infected, and there were numerous clusters of setæ at the edge, also clusters of spores, and in the interior of the cotyledon spores borne on scattered basidia. Ten days from the time of inoculation another plantlet was diseased, both cotyledons being affected. When the distal half was pretty well dead and shriveled the examination was made. Very few external signs of the fungus were present, but in a few places at the edge the setæ were just piercing through, and sections showed numerous spores and clusters of the special bodies which bear the setæ. The base of each cotyledon was apparently healthy and each was still firmly attached to the stem.

I have not yet attempted to inoculate the plants in any other way than through the cotyledons, but the success attained has suggested that perhaps the plants when not injured in any way are only liable to infection through the cotyledons as in the well-known cases of *Cystopus candidus* in different species of *Cruciferæ.* How far this is true must be determined by future experiments.

The *Colletotrichum* on cotton seems to have been hitherto an undescribed species. Since completing this work thus far I found that Miss E. A. Southworth had been giving the fungus some study, having had specimens of it on cotton bolls. She has proposed the name *Colletotrichum gossypii*, n. sp., which is eminently appropriate.

DESCRIPTION OF PLATE.

Fig. 1. Spores showing variation in shape and size.
2. Spores germinating in artificial cultures.
3. Farther development.
4, 5, 6, 7. Spores germinating and some of the hyphæ producing the dark-brown cells.
8. Spores germinating in pure water, producing immediately the special cells.
9. Spores germinating in weak nutrient medium producing special cells and a few spores.
10. Same.
11. Growth from one spore in rich nutrient medium 65 hours from time of sowing, showing crown clusters of spores around ends of fertile hyphæ; one of the special cells by budding has produced an imperfect sclerotium.
12. Ends of hyphæ in an old culture showing special cells and one seta.
13. Section through acervuli on boll.
14. Same, more highly magnified.
15. Section from stem showing special cells and imperfect sclerotia and origin of setæ.
16. Peculiar enlarged cells from a cluster.
17. Setæ from old specimens on dried part of boll.
18. Setæ from leaf.
19. Young setæ from cotyledon of one of the plants inoculated with spores from a boll.

Figs. 2–12. From artificial cultures, 13 to 18 from natural specimens, 19 from inoculation.

All excepting 13 drawn to the same scale with aid of camera lucida. Fig. 13 drawn with aid of camera lucida to smaller scale.

MYCOLOGICAL NOTES II.

PLATE VII.

By GEORGE MASSEE.

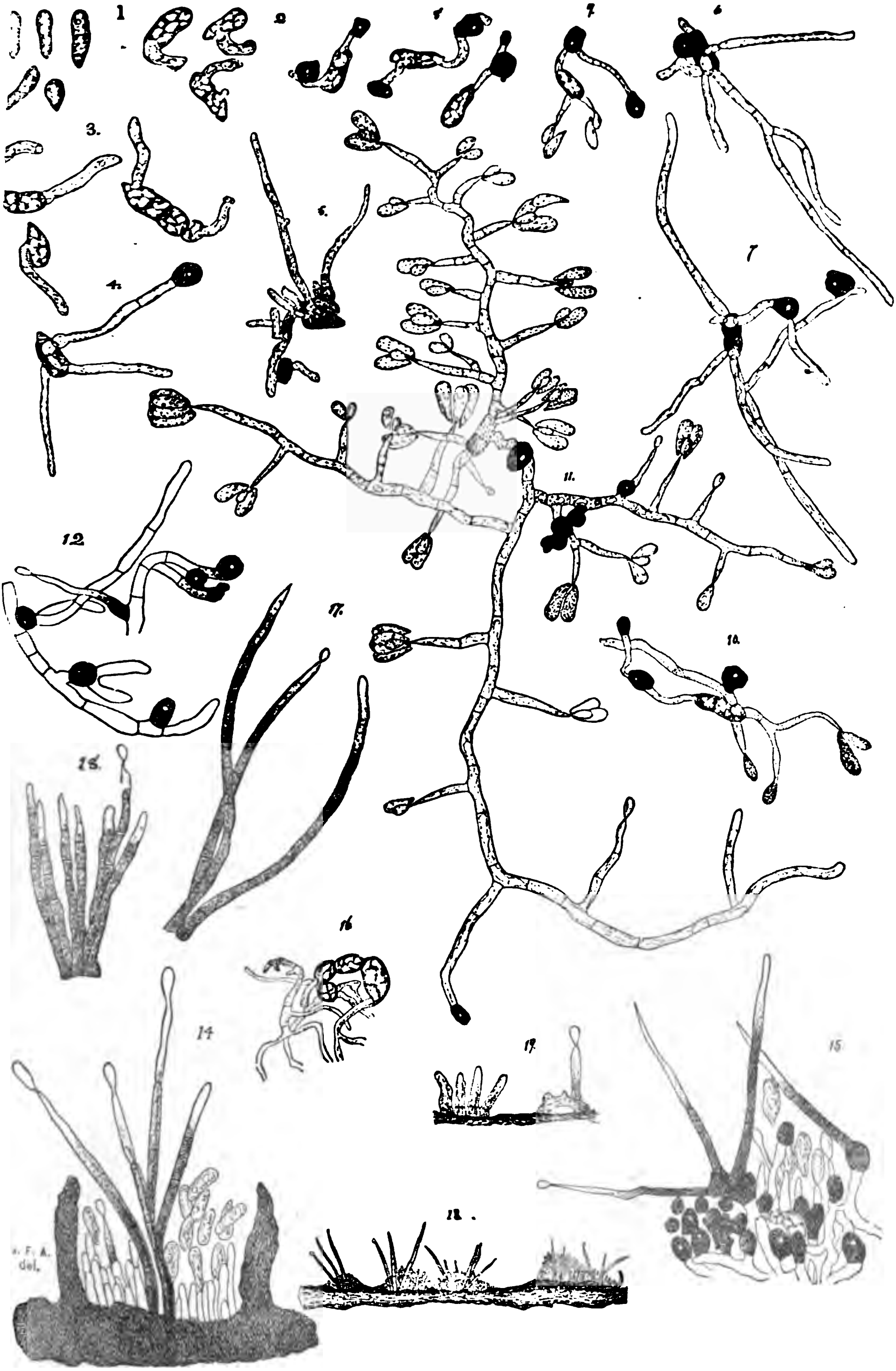
SARCOMYCES, Mass., (*nov. gen.*)

Receptacle subgelatinous, subsessile, erumpent, attached by a narrow base; hymenium convex, even, margin acute; asci cylindrical; spores uniseriate, colored, muriformly septate; paraphyses numerous.

Allied to *Hæmatomyxa*, Sacc., but distinguished by the even marginate hymenium and the uniseriate spores. It is doubtful whether the last-named genus really belongs to the *Bulgarieæ*.

SARCOMYCES VINOSA, Mass. (Figs. 1–3.) Erumpent; substipitate, expanding into a more or less circular fleshy disk, plane or convex below, margin acute, patent when moist, incurved when dry; hymenium convex, even, every part perfectly glabrous and dark purple-brown; asci cylindrical, attenuated and usually curved at the base; spores uniseriate, four in an ascus, elliptical, ends subacute, usually rather oblique, at first triseptate then with septa formed parallel to the long axis of the spore, slightly or not at all constricted at the septa, clear brown,

ATKINSON ON COTTON ANTHRACNOSE.



ATKINSON ON COTTON ANTHRACNOSE.

21–24 by 8–10μ; paraphyses linear, colorless, not incrassated at the tips, aseptate, equal in length to the asci, very numerous, 2–5μ thick.

Tremella vinosa, Berk. & Curt., in Herb. Berk. On wood. Venezuela; S. Carolina, Rav. Type in Herb. Berk., Kew, No. 4285.

From two-thirds to 1 inch across, solitary, or 2–3 in clusters, subgelatinous when moist, cartilaginous and much contracted when dry. With very much the habit and general appearance of *Bulgaria inquinans*, but of a dark purple color.

PEZIZA PROTRUSA, B. & C. (Figs. 8 to 11.) Hypophyllous, gregarious, erumpent, bordered by the torn, upraised cuticle; hymenium plane or concave, whitish, hypothecium very thin; margin of cup slightly raised, composed of parallel septate hyphæ, each terminated by a large, olive-brown cell; asci subcylindrical, 55–60 by 5–6 μ; spores irregularly biseriate, cylindrical, tips obtuse, smooth, colorless, 5–6 by 1.5μ, paraphyses absent.

Peziza protrusa, B. & C., Grev., Vol. III, p. 159.

Pseudopeziza protrusa, (B. & C.) Rehm, Ascom. No. 310. Sacc. Syll. VIII, No. 2980.

Pyrenopeziza protrusa, (B. & C.) Sacc. Syll. VIII, No. 1503. (Type in Herb. Berk., Kew, No. 7815.)

On the leaves of *Magnolia glauca*, Lower Carolina. Gregarious, rarely crowded, up to 0.5 millimetre in diameter. I have not been able to detect paraphyses in the specimen examined. Usually circular and patellate, the irregularity of the opening being due to the mode of rupture of the epidermis.

STAMNARIA PUSIO, (B. & C.) Mass. (Figs. 16–18.) In clusters of 2–3 from a common stem, every part horny and translucent when dry; cups urceolate or subglobose; mouth contracted, externally smooth, even, grayish, or horn colored; hymenium concave, orange, asci cylindrical, slightly narrower at base; spores 8, uniseriate, elliptic-oblong, smooth, colorless, 15 by 7–8μ; paraphyses numerous, linear, septate; the cups pass downward into slender stems which combine to form a thickened, root-like portion.

Peziza pusio, B. & C., Grev., Vol. III, p. 153; Cke., Mycogr. 106.

Sarcoscypha pusio, Sacc. Syll., Vol. VIII, No. 624. (Type in Herb. Berk., Kew, No. 7451.) On the ground. Texas. (C. Wright.)

The whole fungus 1 inch or more high; substance hard and horny when dry; hyphæ thick-walled, densely interlaced, the walls becoming gelatinous and cemented together.

PSILOPEZIA MIRABILIS, B. & C., Journ. Linn. Soc., Vol. X, p. 364; Sacc. Syll., Vol. VIII, No. 616, is synonymous with *Aleurodiscus Oakesii*. Type in Herb. Berk., No. 7402.

CYPHELLA TELA, (B. & C.) Mass. (Figs. 12, 13.)

Gregarious on a dense white subiculum; cups minute, 150–180μ diameter, subglobose; mouth at first small, becoming expanded, but the acute margin always remains more or less incurved; externally

blackish brown, frosted with glistening crystals of oxalate of lime; hymenium concave, even, naked, blackish brown; basidia clavate, tetrasperous; spores subglobose or broadly pyriform, smooth, pale brown, 7 by 5μ.

Peziza telo, Berk. & Curt., Grev., Vol. III, p. 156 (1875).

Tapesia tela, (B. & C.) Sacc., Syll. Vol. VIII, No. 1539.

On wood. Lower Carolina. (Type in Herb. Berk., Kew, No. 7724.)

The present species, owing to its dark color and gregarious habit, also being furnished with a dense, white, broadly effused, superficial mycelium, suggests the genus *Peziza* when examined under a low power, but is a true *Cyphella*.

DACRYOPSIS, Mass., (*nov. gen.*)

Small subgelatinous fungi, fertile portion capitate, sharply defined, terminal on a more or less elongated stem composed of parallel, simple or branched septate hyphæ; at the apex of the stem the hyphæ are very much interlaced, forming a compact expanded layer from which originates in the first instance numerous slender gonidiophores spreading on every side to form a more or less capitate head; gonidia minute, one-celled, forming a dense layer; basidia cylindrical, bifurcate, aseptate, springing from the interlaced layer of hyphæ at the apex of the stem, either contemporaneous with, or later than, the gonidiophores; spores simple or septate.

Coryne, Berk., Grev. Vol. II, p. 33 (in part).

Ditiola, Berk., Ann. Nat. Hist., Ser. 2, Vol. II, p. 267, Pl. IX, Fig. 4.

Tremella, Sacc. Syll. Vol. VI, p. 780 (in part).

Coryne, Sacc. Syll. Vol. VIII, p. 641 (in part).

During the gonidial stage the structure is identical with that of the form-genus *Tubercularia*, the stem is often more elongated than in the last-named genus, but in *Dacryopsis nuda* even this unimportant difference disappears. The basidia and spores closely resemble those met with in *Dacryomyces*, to which genus the present is closely allied, differing in the structure of the stem and in the arrangement and form of the gonidiophores.

The gonidial phase of *Dacryopsis nuda* is morphologically almost indistinguishable from the form species known as *Tubercularia vulgaris*, Tode, but it is well known that the latter is the gonidial condition of the ascigerous fungus called *Nectria cinnabarina*, Fr., hence it is seen that two structures almost indistinguishable in the gonidial form may be conditions of ascomycetous and basidiomycetous fungi, respectively. Again, it is known that the gonidial condition of various species of *Nectria* belongs to such morphologically distinct form genera as *Tubercularia*, *Fusarium*, *Volutella*, etc., consequently it appears to be at least indiscreet to assume, much more to assert, that because a gonidial form presenting certain morphological features has been clearly proved to be a condition of some higher fungus belonging to a given genus that

another gonidial form of similar structure must necessarily be a condition of some hypothetical species of the same genus. Such assumptions do not harmonize with the stated belief of those mycologists who consider that a complete life history is necessary to prove relationship or otherwise in suspected cases, a belief that has brought conviction to the mind of most disciples of the Friesian school, whose conceptions of affinity are based on characters derived from mature examples, which in many instances are of no genetic value. On the other hand, it is to be regretted that the modern school, having adopted the only known reliable test of affinity—life history—should endeavor to indicate affinity from analogy to such an extent as is too frequently done. The close morphological agreement between the gonidial condition in the present genus and in *Coryne* further illustrates the same idea.

DACRYOPSIS GYROCEPHALA, Mass. (Figs. 4–7.) Gregarious or scattered; head hemispherical, plane below, with ridges arranged in a gyrose manner, dark purple, blackish purple when dry; stem equal or slightly incrassate above, smooth, even, pale, tan-colored, 2–3.5 millimetres long, about 1.5 millimetre thick; gonidiophores covering every part of the head, simple, aseptate, straight, 40–50 by 1.5μ; gonidia terminal continuous, colorless, elliptic-oblong, 2.5 by 1μ; basidia projecting beyond the gonidiophores, aseptate, cylindrical, bifurcate near the apex, 60–65 by 6–7μ; spores continuous, colorless, elliptic-oblong, slightly curved, with an oblique apiculus at the base, 15–16 by 4–4.5μ; clavate paraphyses numerous, shorter than the gonidiophores.

Tremella (*Coryne*) *gyrocephala*, B. & C., Grev., Vol. II, p. 20 (1873). Sacc. Syll., Vol. VIII, No. 2654. (Type in Herb. Berk., Kew.) Lower Carolina. Gregarious, on rotten wood.

The stem attains its full size before the development of the head commences, the latter is at first small and even, but as it increases in size becomes gyrose as in many species of *Tremella* and *Dacryomyces*.

In old specimens the gonidiophores have fallen away, leaving only the basidia and paraphyses.

DACRYOPSIS ELLISINA, Mass. (Figs. 19–21.) Gregarious, head broadly elliptical or elliptic-oblong, smooth, even, pale brown, 4–6 by 2–4 millimetres, stem cylindrical, longitudinally wrinkled, 3–4 by 1.5–2 millimetres, dark brown; gonidiophores covering the entire head, straight, septate, with 1–3 short branchlets near the apex, 40–50 by 2.5μ; gonidia continuous, colorless, elliptic-oblong, very slightly curved, 3 by 1μ; basidia cylindrical, bifurcate at the apex, aseptate, 50–55 by 6μ; spores elliptic-oblong, with an oblique apiculus at the base, 14 by 5μ.

Coryne Ellisii Berk., Grev., Vol. II, p. 33; Sacc. Syll., Vol. VIII, No. 2655. Potsdam, New York. (Ellis.) On decaying basswood log. (Type in Herb. Berk., Kew.)

DACRYOPSIS UNICOLOR, Mass. (Figs. 22–24.) Gregarious; entire fungus, blackish brown; head globose, small, smooth, even, 1.5–2 millimetres diameter; stem elongated, erect, slightly attenuated upwards,

vaguely longitudinally rugulose, 5–8 by 1–1.5 millimetres; gonidiophores covering every portion of the head, linear, curved, septate, with a few short lateral branchlets, 70–80 by 1.5μ; gonidia elliptic-oblong, continuous, colorless, 3–1μ; basidia appearing after the gonidiophores, aseptate, bifurcate at the apex, 45–50 by 5–6μ; spores continuous, colorless, elliptic-oblong, with an oblique apiculus at the base, 15 by 4–4.5μ.

Coryne unicolor, B. & Curt. Type in Herb. Berk., Kew, No. 4310. On rotten wood, Cuba. (Wright.)

I have not seen any previous description of the present species; possibly such may exist along with others of the same genus in some American publication.

DACRYOPSIS NUDA, Mass. (Figs. 25–26.) Gregarious; head hemispherical, flattened below, at first even, then minutely rugulose, reddish orange, 3–4 millimetres diameter; stem short, stout, equal, white, or tinged with yellow, minutely tomentose, 3–4 by 2–2.5 millimetres, even; gondiophores appearing before the basidia, linear, straight, aseptate, simple, or rarely with one or two short branchlets near the apex, 35–40 by 1.5μ; gonidia elliptic-oblong, continuous, colorless, 3 by 1μ; basidia projecting considerably above the gonidiophores, cylindrical, bifurcate at the apex, 55–60 by 5–6μ; spores elliptic-oblong, colorless, with an oblique apiculus at the base, triseptate, 14 by 5μ.

Ditiola nuda, Berk. Ann. Nat. Hist., Ser. II, Vol. II, p. 267, Pl. IX, Fig. 4 (Berkeley's No., 375). Britain. On fir stumps.

Closely resembling in general appearance *Tubercularia cinnabarina*, but quite distinct morphologically.

DACRYOMYCES ENATA, (B. & C.), Mass. (Figs. 14, 15.) Erumpent; dark amber, appressed, surface slightly rugulose or almost smooth, bounded by the ruptured bark, up to 1 centimetre diameter; basidia cylindrical, bifurcate at the apex, 45–50 by 5μ; spores elliptic-oblong, colorless, with an oblique apiculus at the base, slightly curved, 10–11 by 3.5μ.

Tremella enata, Berk. & Curt., Grev., Vol. II, p. 20; Sacc. Syll., Vol. VI, No. 8424. Superficially resembling a small discolored form of *Tremella albida*, but a true *Dacryomyces*. From 3 millimetres to 1 centimetre across. Type in Herb. Berk., Kew, No. 4307. On *Alnus serrulata* and oak, lower Carolina.

TREMELLA VESICARIA, Bull.=*Peziza concrescens*, Schweinitz. (Specimens from Schweinitz in Herb. Berk.)

TREMELLA GIGANTEA, B. & C., Grev., Vol. II, p. 19. Alabama. (Peters.) The present species is a gelatinous lichen. Type in Herb. Berk., Kew, No. 4260.

TREMELLA MYRICÆ, Berk. & Cooke. Foliaceo-gyrose, gelatinoso-elastic, semipellucid, smoky gray, when dry blackish with a tinge of purple here and there, surface with minute, scattered points; spores broadly elliptical, with an oblique apiculus, 8–9 by 6–7μ, colorless.

Tremella myricæ, Berk. & Cke., Grev., VI, p. 133; Sacc. Syll., VI, No. 8422. On bark of *Myrica* and *Persea*, Gainesville, Fla. (Rav.). (Type in Herb. Berk., Kew, No. 4300.)

Forming thin, foliaceous expansions when dry, 1–4 centimetres across. The minutely scabrid surface when dry is characteristic.

DACRYMYCES SYRINGICOLA, B. & C. Erumpent, pale or slightly convex, surface almost even or tuberculated, watery gray or whitish, surrounded by the ruptured epidermis; basidia large, spherical, with four stout, elongated sterigmata, spores colorless, cylindric-oblong, curved, with an oblique apiculus at the base, 32–35 by 8–9μ.

Dacrymyces syringicola, B. & C., Grev., Vol. II, p. 20; Sacc. Syll., VI, No. 8504.

Dacrymyces destructor, B. & C., Grev., Vol. II, p. 20; Sacc., Syll. VI, No. 8505. Both types in Herb. Berk., Kew., Nos. 4324 and 4328.

On *Syringa* and on branches of pear, to which it is very destructive, lower Carolina. Rav.

The only distinction between the two species, as pointed out by Berkeley, depends on the amount of tuberculation of the surface, and even this is not constant. The furcate spores alluded to by Berkley are portions of the septate hyphæ that have become free. Circular or elliptical, often numerous, 3–4 millimetres across, resembling lenticels when dry and contracted.

TREMELLA DEPENDENS, B. & C. Pendulous, elongato-clavate, attached by a slender stem-like base, mucilaginous, pale dingy yellow; the central portion consisting of exceedingly thin hyphæ immersed in mucilage; towards the even surface the hyphæ become thicker and form a compact layer which produces basidia at every part of the surface; basidia spherical with four elongated sterigmata; spores elliptic-oblong, smooth, colorless, 7 by 3–3.5 μ.

Tremella dependens, B. & C., Grev., Vol. II, p.19; Sacc. Syll., Vol. VI, No. 8396. Hanging down from under side of rotten poplar (*Liriodendron*) logs after rain, Alabama. Peters.

The following note accompanied the specimens:

"Sack-like, elongated, round, subclavate, subtranslucent, thin, watery, mucilaginous, dissolving when the thin outer skin is broken, pale, watery, greenish-yellow, $\frac{1}{8}$–1 inch long." The green tinge is due to minute algæ.

TREMELLA RUFO LUTEA, B. & C. A very remarkable form, attached laterally by a broad base, imbricated, resembling *Stereum hirsutum* in habit; more or less reniform or semicircular, margin sometimes lobed, yellow brown or amber, translucent when moist, upper surface irregularly nodulose and with a tendency to form concentric zones due to the arrangement of the nodules, under surface almost smooth; substance thick, very cartilaginous, central portion composed of much-branched hyphæ with thick gelatinous walls; toward the outside, above and below, the hyphæ are dense and parallel, but showing no trace of

differentiation into basidia or gonidiophores. From 4–6 by 3–4 centimetres, and 3–4 milimetres thick at the base, thinner toward the margin. Every portion perfectly smooth. Berkeley's remark "uno puncto affixa," must have been a slip of the pen.

Tremella rufo-lutea, B. & C., Journ. Linn. Soc., 1869, Vol. x, p. 340; Sacc. Syll., Vol. vi, No. 8394.

DESCRIPTION OF PLATE.

1. ***Sarcomyces vinosa***, section, natural size.
2, 3. Ascus, spores, and paraphyses of same, X 400.
4. ***Dacryopsis gyrocephala***, natural size.
5. Same, X 6.
6, 7. Portion of hymenium and spores of same, X 400.
8. ***Peziza protrusa***, X 75.
9. Portion of hymenium and margin of same in section, X 400.
10. Asci and spores of same, X 400.
11. Spores of same, X 1,200.
12. ***Cyphella tela***, X 75.
13. Portion of hymenium of same, X 400.
14. ***Dacryomyces enata***, natural size.
15. Spores of same, X 400.
16. ***Stamnaria pusio***, natural size.
17, 18. Ascus, paraphyses, and spores of same, X 400.
19. ***Dacryopsis Ellisiana***, natural size.
20. Section of portion of hymenium of same, X 400.
21. Gonidiophores and gonidia of same, X 1,200.
22. ***Dacryopsis unicolor***, natural size.
23. Gonidiophores and gonidia of same, X 1,200.
24. Spores of same, X 400.
25. ***Dacryopsis nuda***, natural size.
26. Section of portion of hymenium of same, X 400.

INDEX TO NORTH AMERICAN MYCOLOGICAL LITERATURE.

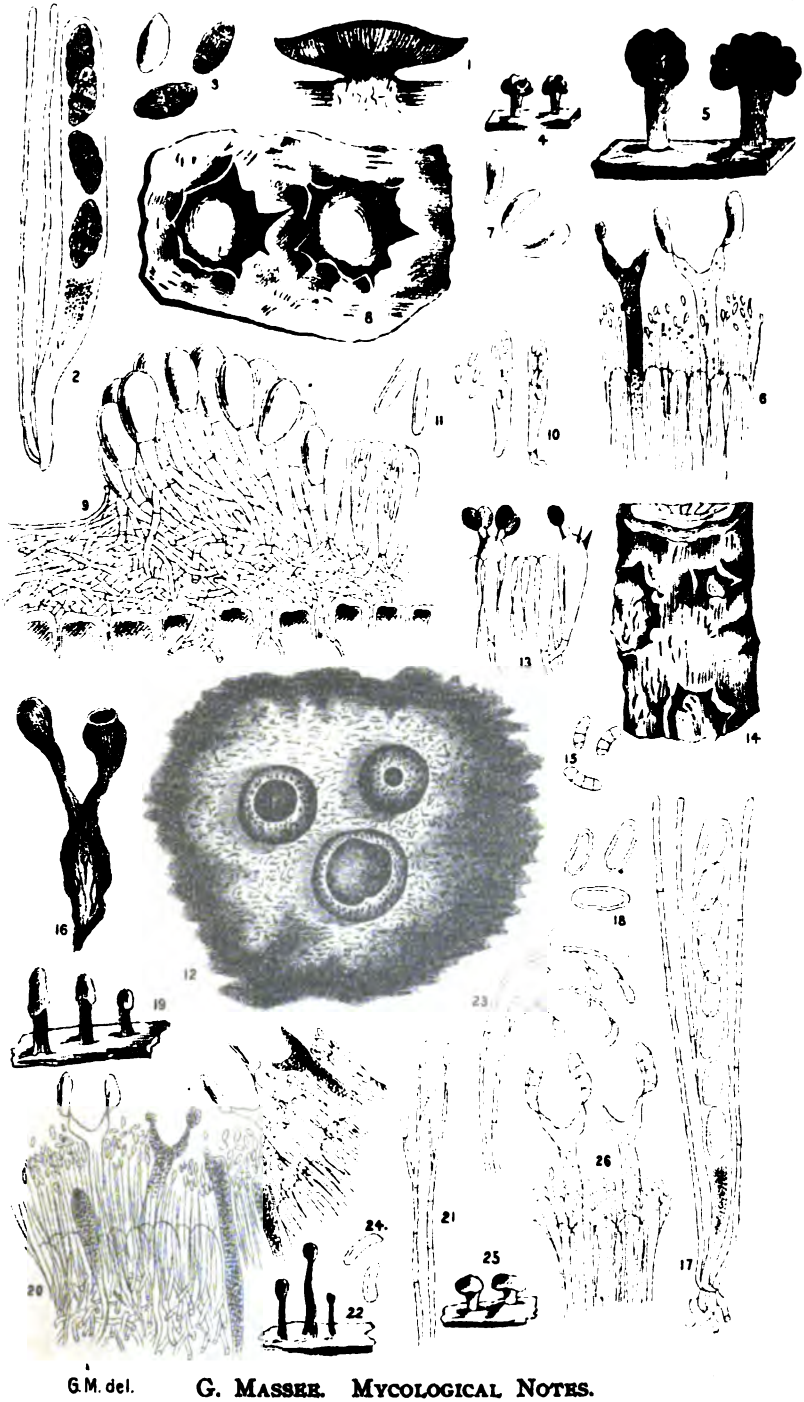
By David G. Fairchild.

177. Anderson, F. W. **Biographical sketch of J. B. Ellis.** Bot. Gaz. Crawfordsville, Indiana, Vol. xv, No. 11, November, 1890, pp. 299–304. Gives an account of the life of this pioneer of North American Mycology.

178. Bailey, L. H. **Peaches and yellows in the Chesapeake country.** American Garden, New York, January, 1891, Vol. xii, No. 1, pp. 20–23. Describes conditions of the disease in Maryland and Delaware. Refers to late investigations of the Division of Vegetable Pathology, showing disease to be of contagious nature not affected by fertilizers.

179. ———. **The peach yellows.** Bull. xxv., Cornell Agr. Ex. Sta. Ithaca, New York, December, 1890, pp. 178–180. Gives account of work of Dr. Erwin F. Smith, of the Department of Agriculture, upon the disease, with note as to the New York State law in regard to the matter.

180. Bessey, Chas. E. **An old botanical letter.** Am. Nat., December, 1890, Vol. xxiv, No. 288, p. 1196. Gives verbatim copy of a letter written by C. H. Persoon to Sowerby, from Göttingen, May 2, 1801, alluding to the latter's "English Fungi."



G.M. del. G. MASSEE. MYCOLOGICAL NOTES.

181. ——. **The host index of the fungi of the United States.** Am. Nat., xxiv, No. 288, December, 1890, p. 1196. Notices work of Farlow and Seymour with word of commendation. (See 126.)

182. ——. **Some bad station botany.** *Ibid.*, p. 1197. Criticises bulletin of Ohio Experiment Station upon wheat smut.

183. ——. **Wheat smut.** *Ibid.* Notices excellent work of Kellerman and Swingle in Bull. 12 of Kans. Ag. Experiment Station. (See 157.)

184. ——. **North American species of Tylostoma.** *Ibid.*, p. 1199. Refers to work by A. P. Morgan upon the revision of the genus *Tylostoma*.

185. ——. **New North American fungi.** *Ibid.* (See 124.)

186. BOYLE, D. R. **A parasitic fungus.** The Microscope, November, 1890, Vol. x, No. 11, p. 343. Note given of discovery at Cape Breton of larva of May beetle attacked by fungus arising from the head. (Name not given.) Specimen sent to Nova Scotian Institute of Natural Sciences by Mr. Boyle.

187. BRAIARD, MAJOR. **Champignons nouveaux.** Revue Mycologique, Toulouse, October, 1890, No. 48, p. 177. Describes *Physalospora pseudo-pustula* (Berk. & Curt.) Braiard & Hariot, (*Sphæria pustula*, B. & C.) on rotten leaf from United States, Farlow, legit.

188. BURRILL, T. J. **Preliminary notes upon the rotting of potatoes.** Proc. Eleventh Ann. Meeting Soc. for Promotion of Agricultural Science, Indianapolis, Indiana, August, 1890. Notes as genetically connected with the rot of Irish potato tubers a species of bacterium, and records its isolation on culture media with inoculations upon healthy tubers.

189. ——. **A bacterial disease of corn** (with fig.). Third Ann. Report of Illinois Ag. Ex. Sta., 1889–1890 (issued 1890). Extract from Bull. No. 6, Illinois Ag. Ex. Sta. Mentions inoculation experiments with pure cultures of bacterium as causing disease, with opinion that the same germs may cause death of cattle when diseased corn stalks are eaten.

190. COOKE, M. C. **Some exotic fungi.** Grevillea, June, 1890, Vol. 18, No. 88, p. 86. Describes *Lizonia sphagni*, n. s., on dead *Sphagnum* from Maine and *Valsa* (*Eutypella*) *clavulata*, n. s., on *Ailanthus* bark. Collected by Mrs. Britton on Staten Island.

191. ——. **North American fungi**, Grevillea, September, 1890, Vol. xix, No. 89, pp. 14–15. Describes *Cyphella fumosa*, n. s. On rotting leaves of *Gladiolus*, South Carolina, *Rhabdospora sabalensis*, n. s., on *Sabal*, South Carolina. *Stilbum* (*Ciliciopodium*) *aurifilum*, Gerard., on *Dædalea unicolor*, United States, and *Uredo amsoniæ*, n. s., on *Amsonia*, South Carolina.

192. DUDLEY, W. R. **The hollyhock rust** (with fig.). Bull. xxv, Cornell Ag. Ex. Sta., Ithaca, New York, December, 1890, pp. 154–155. Gives popular description of *Puccinia malvacearum*, Mont., suggesting as a remedy permanganate of potash, two tablespoonfuls of saturated solution to 1 quart of water; applied with a sponge.

193. ELLIS, J. B., AND EVERHART, B. M. **The North American Pyrenomycetes.** A contribution to mycologic botany. Bull. Torrey Bot. Club, New York, January 1891, Vol. xviii, No. 1, p. 31. Give notice of subsequent appearance of the work by placing advance sheets in the hands of the editors of the Bulletin.

194. GALLOWAY, B. T. **Note on the nomenclature of Uncinula spiralis, B. & C.** Bot. Gaz., December 26, 1890, Vol. xv, No. 12, p. 339. Gives correct synonymy of the species, preferring *Uncinula spiralis*, Berkeley & Curtis, 1857.

195. ——. **Some recent observations on black rot of the grape.** *Ibid.*, pp. 60–63. Gives the results of three experiments to prove the relationship between *Phyllosticta labruscæ*, Thüm., *P. ampelopsidis*, E. & M., and *Læstadia Bidwellii* (Ell.) V. & R. Records characteristic *Phyllosticta* spots upon *Ampelopsis* and *Vitis* from sowings of ascospores of *Læstadia Bidwellii* (Ell.), V. & R., and entirely negative results from all sowings of pycnidia spores. (See 130.)

196. ——— AND FAIRCHILD, D. G. **A comparative test of some of the copper preparations in the treatment of black rot of grapes.** Proc. 11th Ann. Meeting Society for the Promotion of Agricultural Science, Indianapolis, Indiana, August 18, 19, 1890, pp. 59, 60 (issued December, 1890). Give result of experiments in Virginia to test comparative efficacy of Bordeaux mixture, ammoniacal solution of copper carbonate, copper carbonate in suspension, and combination of Bordeaux mixture and ammoniacal solution of copper carbonate, three treatments of the former, five of the latter. Conclude Bordeaux to have saved the largest per cent of fruit, but ammoniacal solution to be most economical.

197. GARMAN, H. **Some strawberry pests; the strawberry leaf-blight fungus.** Bull. 31, Kentucky Ag. Ex. Sta., December, 1890, Lexington, Kentucky, pp. 3-13. Describes disease with figures giving results of careful experiments with Bordeaux mixture, eau celeste, liver of sulphur, and London purple as preventives. Concludes Bordeaux, applied at intervals of two weeks after removal of berries, most effective in prevention of *Ramularia Tulasnei*, Sacc., eau celeste standing second, and London purple, although better than no fungicide, standing last. Thinks the removal of diseased leaves in summer, if not followed by fungicidal applications, more injurious than beneficial, because lessening shade to young leaves.

198. HALL, CLIFFORD C. **Stinking smut of wheat.** The Modern Miller, Kansas City, Missouri, October 1890, Vol. 14, No. 9, p. 255 (with fig. from Bull. 12, Kans. Ex. Station). Gives short extract from Bull. 12, Kans. Ag. Ex. Station, 1890. (See 157.)

199. HALSTED, B. D. **Some fungous diseases of the sweet potato.** Bull. 76, New Jersey Ag. Ex. Station, New Brunswick, New Jersey, November 28, 1890 (with numerous figures). Describes, with figures and recommendations for treatment, soft rot, (*Rhizopus nigricans*, Ehr.), black rot (*Ceratocystis fimbriata*, Ell. & Hals., n. s.) soil rot, (*Acrocystis batatus*, Ell. & Hals., n. s.) stem rot, white rot (*Penicillium*, sp.), dry rot, (*Phoma batatæ*, Ell. & Hals., n. s.) scurf, (*Monilochætes infuscans*, Ell. & Hals. n. s.) leaf-blight (*Phyllosticta bataticola*, E. & M.), leaf mold [*Cystopus ipomææ-panduranæ*, (Schw.) Farl]. A very valuable bulletin of monographic nature, to furnish a basis for experimental work upon the diseases of this important crop.

200. ———. **Notes upon Peronosporeæ for 1890.** Bot. Gaz., December 26, 1890, Vol. XV, No. 12, pp. 320–324. Gives notes of abundance, destructiveness, and previous mention in America of the following: *Phytophthora infestans*, DBy.; *P. phaseoli*, Thax.; *Plasmopara viticola*, (B. & C.), Berl & DeT., on *Vitis*, *Ampelopsis tricuspidata*, and *A. quinquefolia*; *P. Entospora*, Schrœt, on *Erigeron Canadense*; *P. geranii*, (Peck) Berl., on *G. Carolinianum*; *Bremia lactucæ*, Regel, on *L. Canadensis*; *P. parasitica*, DBy., on *Cardamine, hirsuta, C. laciniata, Hesperis matronalis*, and outer leaves of cabbage; *P. violæ*, DBy., on *Viola*, sp.; *P. Cubensis* on cucumbers; *P. effusa* on *Spinacea*; *P. Ficariæ*, Tul., on *Ranunculus abortivus*; *P. alta*, Fl., on *Plantago major*, *P. lanceolata*, and *P. Virginica*: *P. obovata*, Bonord. on *Spergula arvensis* found with *Puccinia spergulæ*, DC., a new rust to this country; *Cystopus ipomææ-panduranæ*, (Schw.) Farl.

201. ———. **A new anthracnose of peppers** (with fig.). Bull. Torr. Bot. Club, Vol. XVIII No. 1, pp. 14–15. Describes as new *Colletotrichum nigrum*, Ellis & Halsted, which attacks and causes serious damage to the fruits of *Capsicum annuum* in New Jersey.

202. ———. **The rot among late potatoes.** Garden and Forest, New York, November 12, 1890, Vol. III, No. 142, p. 551 (1 column). Notes destructiveness in New Jersey in 1890. Recommends spraying with copper compounds.

203. ———. **The root rot of salsify.** Garden and Forest, New York, November 26, 1890, Vol. III, No. 144, p. 576 (1 column). Notes disease of salsify closely connected with bacteria; which bacteria are able to cause rot in the egg plant, sweet potato, white potato, onion, and apple. The germ not isolated in cultures.

204. ———. **The cranberry scald** (with figs.). Garden and Forest, New York, December 3, 1890, Vol. III, No. 145, p. 583 (2 columns). Gives account of the scald with conditions probably favorable to the development of the disease, as decaying vegetation and stagnant water.

205. ———. **The mignonette disease.** Garden and Forest, New York, January 21, 1891, Vol. IV, No. 152, p. 33 (half column). Notes destructive case of *Cercospora resedæ*, Fckl., upon hot-house mignonette, recommending Bordeaux mixture as preventive.

206. ———. **The potato rot; its nature, and suggestions for checking it in the future** (with fig.). Rural New Yorker, New York, Vol. XLIX, No. 2129, p. 771, November 15, 1890. Popular exposition of subject, suggesting remedies.

207. ———. **The rots of the sweet potatoes.** Proc. 11th Ann. Meeting Society for the Promotion of Agricultural Science, Indianapolis, Indiana, August 18, 19, 1890, pp. 27–28 (issued December, 1890). (Abstract.) Discusses briefly ground rot, soft rot, black rot, or black root, yellow rot or stem rot, and dry rot, giving general characters and results of investigation. Notes *Rhizopus nigricans* as cause of soft rot and *Penicillium* as cause of dry rot.

208. HARIOT, P., AND KARSTEN, P. A. **Micromycetes novi.** Revue Mycologique, Toulouse, July, 1890, No. 47. Describes *Calosphæria smilacis*, Kars. & Har., on *Smilax* from Ohio, legit Lesquereux. *Cornularia Rhois*, (Berk. ?) Karst. *Sphæronema Rhois*, Berk. Syn. ? On *Rhois* from Ohio, legit Lesquereux; *Phoma picea* (Pers.) Sacc., var. *chenopodii*, Karst & Har. on *Chenopodium* from Ohio, Lesquereux legit.

209. HOWELL, J. K. **The clover rust** [*Uromyces trifolii*, (Alb. & Schw). Wint.]. Bull. XXIV, December, 1890. Cornell Univ. Ag. Ex. Sta., Ithaca, New York, pp. 129–139. (with figs.). Note by W. R. Dudley. Gives occurrence, distribution, and injuriousness of the parasite, with careful description of vegetative and reproductive organs and observations on development; also, an account of artificial cultures and infections. Concludes the fungus to be propagated throughout the growing season by *Uredo* spores, which prefer a low temperature in germination, and are genetically connected with the æcidial stage.

210. JONES, L. R. **The potato rot and apple scab.** Newspaper Bull. No. 2, Vermont Agr. Ex. Sta., Burlington, Vermont, 1890. Popular description of fungi causing diseases, with formulæ for copper compounds and directions for treatment.

211. KELLERMAN, W. A. **More about smut of oats.** Industrialist, Manhattan, Kansas, January 24, 1891, Vol. XVI, No. 18, p. 69 (1¼ columns). Announces the preparation of Bull. 15, Kans. State Agr. Ex. Station to appear subsequently. Records the discovery of quantities of hidden smut in plats of oats, pointing to a too low estimate of injury. Claims for the Jensen hot-water method augmentation of oat crop in excess of that due to prevention of the smut, mentions as promising fungicide, one-half per cent solution of potassium sulphide, 1 pound to 24 gallons of water, leaving seed in the solution 24 hours. Gives as probable loss from smut in Kansas for 1888–'89–'90 a little less than six millions of dollars.

212. ——— AND SWINGLE, W. T. **Preliminary experiments with fungicides for stinking smut of wheat.** Report of Kansas State Board of Agr. for month ending August 31 (issued October 1, 1890), pp. 5–29, with plate. Reprint Bull. 12 of Botanical Dept. Agr. Ex. Sta., Manhattan, Kansas, August 1890 (issued October 1). (See 157.)

213. LAGERHEIM, G. DE. **Note sur un nouveau parasite dangereux de la Vigne** (*Uredo Vialæ*, sp. nov). Comptes Rendus, Paris, Tome CX, 1890, p. 728, and Rev. Gen. de Bot., September 15, 1890. Describes *Uredo Vialæ* as a new Uredineæ upon leaves of *Vitis* found in Jamaica near Rockfort. Decides it entirely different from *U. vitis*, Thüm., which is not a fungus. Of special interest as the first recorded *Uredineæ* upon *Vitis*. Name in honor of P. Viala.

214. LELONG, B. M. **Fungous growths.** Thirteenth Ann. Report of Secretary of California State Board of Agr. Supplement, pp. 242–249 (with 1 lith. plate). Gives general description of fungi, quoting from Harkness, California State Board of Hort, 1883, and treats of Shot-hole apricot fungus (*Septoria cerasina*, Pk.) (with fig.), mentioning spread of disease to peach, plum, prune, and even apple and pear trees adjacent to apricots. Suggests various remedies. Pear cracking and leaf-blight (*Entomosporium maculatum*, Lév.) (with figs.), quotes from Galloway's report, U. S. Dept. Agriculture, both as to fungus and remedies. Recommends as most successful remedy applied both for scale and fungus, sulphur 3 pounds, caustic soda (98 per cent) 2 pounds, whale oil soap, 25 pounds made up to 100 gallons. Apple scab [*Fusicladium dendriticum*, (Wallr.) Fckl.] (with fig.), gives summary of description and treatment of diseases in Report of U. S. Dept. Agr. 1887, also results of Professor Taft's Experiments, in Bull. 11, Div. Veg. Path., U. S. Dept. Agr. (See 104.)

215. MAYNARD, S. T. **Fungicides and insecticides on the apple, pear, and plum.** Bull. No. 11. Mass. Hatch Ex. Sta. Gives results of experiments in which the ammoniacal solution of copper carbonate mixed with Paris green solution injured the foliage and proved ineffectual against the scab (*Fusicladium dendriticum*). Mixtures of Bordeaux with Paris green proved equally ineffectual. Decides plum wart (*Plowrightia morbosa*), to be controllable by use of kerosene mixed with some bright colored pigment and also kept in check by use of Bordeaux. Gives analysis of 10 pounds of grapes, attached to stems and detached from stems, sprayed vigorously with Bordeaux as showing respectively 0.00996 and 0.00031 pound of copper oxide. Thinks Bordeaux effectual in treatment of mildew and "rot."

216. MCILVAINE, CHAS. **Nature's peasants—Toadstools.** Youths' Companion, February 27, 1890, p. 114 (2 columns with figs.), treats in popular way of edible fungi, giving means of distinction.

217. PAMMEL, L. H. **Some fungus root diseases.** Proc. 11th Ann. Meet. Soc. for Prom. of Agricultural Science, Indianapolis, Indiana, August 1890, pp. 91–94. Gives general account of root diseases with special mention of a sclerotium root disease of *Helianthus annuus* resembling somewhat *Sclerotinia sclerotiorum*. Records experiment with iron sulphate, copper sulphate, chloride of lime, sulphur, and various fertilizers against cotton-root rot which proved wholly unsuccessful. Suggests rotation of crops as best method of dealing with such parasites.

218. PANTON, J. HOYES. **Smut; its habit and remedies.** Bull. LVI, Guelph Agricultural College, Guelph, December 9, 1890. Describes popularly *Tilletia caries* (bunt or stinking smut), *Ustilago carbo* (common or loose smut), recommending as remedies clean seed, copper sulphate 1 pound to 1 gallon of water, caustic potash, 1 pound in 6 gallons of water, brine, and immersion for 5 minutes in water at 135° F. or for 15 minutes in water at 132° F.

219. PATOUILLARD, N. **Fragments mycologique.** Journal de Bot., No. 10, 1890, describes *Ithyphallus cucullatus*, n. s. on the earth, Cambridge, Massachusetts. From herbarium of W. G. Farlow.

220. PECK, C. H. **Wheat smut and its treatment.** Cult. and Country Gent., Albany, New York, October 30, 1890, Vol. LV, No. 1970, p. 855 (2 columns). Describes in popular language the diseases caused by *Ustilago tritici*, *Tilletia fœtens*, and *T. tritici*, giving extract from Bull. 12, Kansas Ag. Ex. Sta., containing description of Jensen hot-water method of treatment. (See 157.)

221. ———. **Potato rot. Bordeaux mixture.** Cult. and Country Gent., Albany, New York, November 30, 1890, Vol. LV, No. 1973, p. 916 (half column). Replies to inquiry about disease, recommending the Bordeaux mixture as remedy against *Phytophthora infestans*, DBy.

222. PIERCE, GEO. J. **Notes on Corticium Oakesii, B. & C., and Michenera artocreas, B. & C.** (with plate). Bull. Torr. Bot. Club, New York, December 9, 1890, Vol. XVII, No. 12, pp. 301-310. Clears up the question of the method of spore formation in *Corticium Oakesii*, B. & C., deciding the basidial spores to be borne on basidia which are modified and developed paraphyses whose bristles have become larger fewer, longer, and more erect; and the conidial spores to appear upon similar bristles either before or after the formation of basidial spores. Decides the species of *Corticium* to be distinct from *C. amorphum*. Arrives at the conclusion in case of *Michenera artocreas* that a basidial stage does not exist, or is replaced by the conidial stage, which consists of flask-shaped mother cells containing single conidia and provided with flagellate tips.

223. PIERCE, N. B. **The mysterious vine disease.** Thirteenth Ann. Report California State Board of Horticulture, Sacramento, California, pp. 169-177. Compares the disease with *folletage* and *mal nero*, French and Italian diseases which bear a more or less close relation to it. Gives results of field and laboratory investigations, history of the spread and characteristics of the movements of the disease in California. Decides the malady not to be due exclusively to ordinary parasitic vine fungi, giving various views as to the cause of *folletage* and *mal nero*.

224. REX, GEO. A. **Descriptions of three new species of Myxomycetes, with notes on other forms in century XXV of Ellis & Everhart, North American fungi.** Proc. Acad. Nat. Sci., Philadelphia, Part II, April-September, 1890, pp. 192-196. Describes as new *Physarum tenerum*, Rex, No. 2489, N. A. F., *Trichia subfusca*, Rex, No. 2495, *Trichia erecta*, Rex, No. 2496. Gives variations found to exist in *Didymium eximium*, Pk., No. 2493, N. A. F., and No. 2089, N. A. F., and thinks the two specimens distributed under these numbers referable to the above extremely variable species. Redescribes, on account of inadequacy of former descriptions, *Badhamia lilacina*, Fr., No. 2494, N. A. F.

225. ———. **Notes on the development of Tubulina cylindrica and allied species of Myxomycetes.** Bot. Gaz., December 26, 1890, Vol. XV, No. 12, pp. 315-320. Considers the formative plasmodium and subsequent stages in its relation to the systematic study of the *Myxomycetes*, citing various species to show the constancy of color in plasmodia of the same species. Expresses opinion that the color of corresponding stages of development of individual sporangia from plasmodium to maturity is always the same. Supports this view with observations upon *Tubulina cylindrica*, (Bull.), *T. stipitata*, and *Siphoptychium Casparyi*, Rostfki.

226. SCRIBNER, F. L. **The Entomosporium of the pear and quince** (with figs.). Orchard and Garden, Little Silver, New Jersey, September, 1890, Vol. XII, No. 9, p. 166. Discusses use of the word "blight" for the disease, and, together with popular description and notes on distribution, gives as most effective remedy Bordeaux mixture preceded by early treatments with simple solution of copper sulphate.

227. ———. **Leaf spot disease of the plum and cherry** (*Septoria cerasina*, Pk.) (with figs). Orchard and Garden, Little Silver, New Jersey, October 1890, Vol. XII, No. 10, p. 183 (2 columns). Gives popular description of fungus, with recommendation that copper sulphate be used as preventive.

228. ———. **Fungus diseases of grapevines** (with figs.). *Ibid.* With aid of figures, illustrates characteristics of grape leaf-blight, black rot, and anthracnose upon the leaf, quoting results of experiment in treatment of black rot by the Department of Agriculture. (See 195.)

229. ———. **Bean rust** (with figs.). Orchard and Garden, Little Silver, New Jersey, November, 1890, Vol. XII, No. 11, p. 200-201. With excellent illustrations, describes carefully, in popular language, the life-history of *Uromyces phaseoli*. Recommends spraying with copper compounds and destruction of all infected material in the fall.

230. ———. **Beet Rust** (with fig. from Ann. Rep., 1887, U. S. Dept. of Agr.). *Ibid.*, p. 201. Mentions presence of disease as confined, so far as known, to California. Gives life-history, and suggests as remedies iron chloride in dilute solution.

231. ———. **Powdery mildew of the cherry** (with figs.). Orchard and Garden, Little Silver, New Jersey, December, 1890, Vol. XII, No. 12, pp. 210–211. Describes popularly the life-history of *Podosphæra oxyacanthæ*, recommending as preventive fungicide, sulphuret of potassium, one-half ounce to the gallon of water, applied while warm.

232. ———. **Treatment of anthracnose of the vine.** *Ibid.* (quarter column). Quotes formula for treatment from Le Prog. Agricole, October 26, 1890: Water, 3 gallons; iron sulphate, 7 pounds; copper sulphate, 2 pounds; sulphuric acid, 1 gill. Also, powder made by mixing equal parts of Portland cement and sublimated sulphur.

233. ———. **Rose leaf-blight.** *Ibid.* (with figs.). Gives popular description of *Cercospora rosæcola* and effects upon host. Thinks plants placed where air and light are abundant seldom suffer from the disease.

234. ———. **Beet leaf-blight** (with figs.). *Ibid.* Describes *Cercospora beticola* popularly, and recommends clear and open culture as means of lessening liability to disease.

235. SEYMOUR, A. B. **Rose rusts** (with figs.). American Garden, New York, October, 1890, Vol. XI, No. 10, p. 603. Notices *Phragmidium mucronatum* and *Ph. rosæ-alpinæ*, giving distinctions and life-history. Decides *Ph. mucronatum*, var. *Americanum*, Pk., to be identical with *Ph. rosæ-alpinæ.*

236. STEWART, HENRY. **Cotton rust.** American Agriculturist, New York, December, 1890, Vol. XLIX, No. 12, p. 638 (1 column). Denies popular belief that the disease is in any way connected with the growing of clover, and refers it to the attacks of a fungus (name not given).

237. STOKES, A. C. **A fungous parasite of Diatoms** (with figs. redrawn). The Microscope, January, 1891, Vol. XI, No. I, pp. 24–26. Gives an account of a new genus of fungi (*Septocarpus*) described by Kopf in a monograph, as infecting diatoms in subalpine bog-pools of Norway, and translated by Mr. G. C. Karop in Journal of the Quakett Microscopical Club, London. The species of diatom affected was *Pinnularia*, and the fungus is considered distinct from that attacking Desmids.

238. THAXTER, ROLAND. **The potato scab.** Bull. No. 105, Conn. Agrl. Ex. Sta., New Haven, December, 1890, pp. 3, 4. Gives preliminary report upon the disease which has been proved beyond doubt to be connected, as an effect, with an extremely minute fungus resembling, with exception of a branching character, certain polymorphic bacteria. Records careful inoculation experiments which establish connection between the "deep" scab and the fungus, and gives short account of pure cultures in solid culture media. Mentions work in progress upon morphologically identical fungus found commonly upon refuse material.

239———. **On certain new and peculiar North American Hyphomycetes, I.** (with Plates III and IV), Bot. Gaz., Jan. 15, 1891, pp. 14, 26. Enumerates with valuable notes the American species of the genera *Œdocephalum*, Preuss, as *Œ. glomerulosum* Bull.) Sacc., *Œ. echinulatum*, n. s., *Œ. verticillatum* n. s., *Œ. pallidum* (B. and Br.) Cost. Considering *Œ. elegans*, Preuss, as distinct from *Œ. glomerulosum* and *Œ. roseum*, Cook, as a synonym. Decides *Rhopalomyces pallidus*, B. and Br. and *R. candidus*, B. and Br. to be identical and synonyms of *Œ. pallidum;* and *Haplotrichum fimetarium*, Riess., as also a synonym of the same species. Gives *Rhopalomyces elegans*, Corda, *R. cucurbitarum*, Berk. & Rav., *R. strangulatus*, n. s., as known American members of the genus, and descibes a new genus, *Sigmoideomyces*, upon the species *S. dispiroides*, found upon under side of a moist log, Burbank, east Tennessee. Notes that the genus bears much the same relation to *Œdocephalum* that *Dispira* does to *Aspergillus*. Closes with synopsis of the described species of *Œdocephalum* and *Rhopalomyces.*

240. WEED, C. M. **The scab of wheat heads.** Proc. 11th Ann. Meeting, Society for the Promotion of Agricultural Science, Indianapolis, Indiana, August 18, 19, 1890, pp. 47–48 (issued December, 1890, with figs.). Notes *Fusisporium culmorum*, W. G. Smith, as causing serious damage to the heads of wheat in Ohio.

241. ———. **A second experiment in preventing the injuries of potato blight.** Bull. Ohio Ag. Ex. Sta., second series, Vol. III, No. 8, September, 1890. Gives report of somewhat unsatisfactory experiments against potato blight with use of Bordeaux and ammoniacal copper carbonate solutions. Notes bacterial disease as found by Burrill in Illinois.

242. WINGATE, HAROLD. **Orcadella operculata, Wing. Nouveau Myxomycete.** Revue Mycologique, Toulouse, April, 1890. (November, 1889), No. 46, p. 74. Describes a new family of *Myxomycetes* (*Orcadellaceæ*) consisting of the single species *Orcadella operculata*, found in Fairmount Park, Philadelphia, and also in Maine (Harvey), growing on living trunks of *Quercus rubra*. Considers it to stand in order 4 of Rostafinski after family 13 (*Clathroptychiaceæ*) and unites in a measure the orders *Anemeæ* and *Heterodermieæ*.

GENERAL INDEX.

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[NOTE.—Fungi described in the text are in small capitals, synonyms in italics.]

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U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF VEGETABLE PATHOLOGY.

PERIODICAL BULLETIN. Vol. 6.

THE JOURNAL OF MYCOLOGY:

DEVOTED ESPECIALLY TO THE STUDY OF FUNGI IN THEIR RELATION TO PLANT DISEASES.

EDITED BY

THE CHIEF OF DIVISION AND HIS ASSISTANTS.

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U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF VEGETABLE PATHOLOGY.

Vol. VII. No. 1.

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DIVISION OF VEGETABLE PATHOLOGY.

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PUBLICATIONS OF THE DIVISION OF VEGETABLE PATHOLOGY.

The Division of Vegetable Pathology, formerly a Section of the Botanical Division, has become a separate organization by act of Congress. Its bulletins will henceforth be numbered independently and in a new series; but the following list contains all publications issued since its organization as a Section, together with Bulletin 1 of the new series.

Bulletins and circulars still on hand for distribution are designated by an asterisk (*). Bulletins 1, 3, 4, and 6, omitted from the list, are publications of the Division of Botany, not relating to vegetable pathology.

JOURNALS.

Journal of Mycology, Vol. 5, Nos. 1, 2, 3, and 4. 1889-'90, pp. 249, pl. 14.
Journal of Mycology, Vol. 6, Nos. 1, 2, * 3, * and 4*. 1890-'91, pp. 207, pl. 18.

BULLETINS.

No. 2. Fungous Diseases of the Grape. 1886, pp. 136, pl. 7.
No. 5. Report on the Experiments made in 1887 in the Treatment of Downy Mildew and Black Rot of the Grape. 1888, pp. 113.
No. 7. Black Rot. 1888, pp. 29, pl. 1.
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No. 11.* Report on the Experiments made in 1889 in the Treatment of Fungous Diseases of Plants. 1890, pp. 119.
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VOLUME VII. No. I. } JOURNAL OF MYCOLOGY. { ISSUED Sept. 10, 1891.

SWEET-POTATO BLACK ROT.

(*Ceratocystis fimbriata*, Ell. & Hals.)

By B. D. Halsted and D. G. Fairchild.*

(Plates I—III.)

There are several fungous diseases of the sweet potato known under the general term of rots,† but none of them have equaled in destructiveness the one here to be considered, namely, the black rot. It is by no means a new trouble, for many persons who have grown sweet potatoes for fifty years state that they have known of it from boyhood. The common testimony is, however, that it has increased gradually from year to year, until now in some parts of the country the disease is so bad as to be alarming.

In order to obtain definite data as to the prevalence of the black rot in New Jersey, one of the leading sweet potato growing States, a special bulletin of questions was sent to several hundred of the leading growers. From the replies it was evident that in nearly all portions of the State where sweet potatoes were grown they had been troubled with the black rot. Portions of Maryland and Delaware and the large sweet-potato region of Virginia have also more or less of the disease; in fact, so far as our observation goes, no region is entirely exempt. The exact geographical limits of the disease, however, have not been fixed, and whether or not it is strictly American remains to be ascertained.

The chief damage is seen after some months of storage, when the decay spreads rapidly from root to root, sometimes destroying as much as 25 to 30 per cent of the entire crop. Although no accurate data

* Both Mr. Fairchild and Dr. Halsted having done considerable independent work on sweet-potato diseases, it was thought best to combine their results. With this end in view, Mr. Fairchild spent some time in Dr. Halsted's laboratory in New Brunswick, N. J., where the work done in the Department by Mr. Fairchild and in the former place by Dr. Halsted was carefully compared and carried to more complete results. This paper represents a portion of the work.—[B. T. G.]

† Some Fungous Diseases of the Sweet Potato, Bulletin 76, N. J. Experiment Station, November 28, 1890, pp. 32, figures 19.

could be gathered in regard to the loss from this disease in distinction from the many other rots, 25 per cent is a low estimate for such seasons as that just passed. The rot in question, which, as is usual with fungous diseases, has been ascribed to wet weather, is caused by an interesting species of fungus; but until the authors took the matter into consideration little was known as to the real cause of the malady, and the fact of its fungous origin, while surmised, was not fully established.

EXTERNAL APPEARANCE.

The most conspicuous sign of the disease, and the one which distinguishes it from other diseases, occurs upon the potatoes themselves. It consists in the presence of dark, somewhat greenish spots, varying from a quarter of an inch to 4 inches in diameter, sometimes covering the greater part of the root and extending some distance into the tissue. These spots when once seen can not be mistaken, as they are simply sunken areas with distinct margins, like spots burned into the potato with a metal dye which has left the skin uninjured. Should the slightest doubt as to the identity of the disease remain after a superficial examination, the removal of a small portion of the skin exposing the olive-green tissue below would dispel it. Among the sprouts, or young plants grown in hotbeds, the disease manifests itself in dark lines upon the lower portion of the shoot and sometimes of the lower leaves, giving rise to the name of "black shank" among the growers. These dark lines or blotches often appear upon etiolated portions of the stem and are almost black in color. In very severe cases the tip of the sprout wilts and dies. No appearance in the field has so far been observed that would distinguish hills diseased with black rot from those attacked by some other of the numerous rots; but the dark sunken areas on the potato and the black discolorations of the sprouts can scarcely be confused with any other sweet-potato disease.

CHARACTERISTICS OF THE DISEASE.

A microscopic examination of the discolored tissue in the root reveals the fact that the starch-bearing cells have been greatly altered, the healthy portions are characterized by thin-walled cells completely packed with starch, but these have been replaced in the diseased areas by thick-walled, olive-brown ones totally deprived of starch. The thickening of the walls, seen so strikingly upon examination, is due in part to granular incrustations which often assume the form of rounded protuberances. Whether this incrusting matter is anything more than the remains of the protoplasmic contents of the cell, was not determined, but from its irregular appearance this was the natural inference.

Filling the intercellular spaces and often ramifying through the adjoining cells, are the thick-walled, olive-brown hyphæ of the parasite, and the dark color of the diseased portions is due in a measure to them.

While nothing of the nature of haustoria was observed, it was plainly evident that the presence of this abundant mycelium was the cause of the disease, for wherever the threads of the fungus reached, there were darkened cell walls and lifeless contents. No fungous ferment was observed, and it is probable that as with the *Hymenomycetes* described by Hartig* as attacking forest trees, none exists except at a very limited distance from the tips of the hyphæ.

In the intercellular spaces, and often in the cells themselves are found numerous olive bodies, which for want of a better name we have called *olive conidia*. These olive conidia are most abundant in old specimens where the decay has progressed well into the potato, and although occasionally almost wanting, are generally easily observable. Where present in large quantities they give a decided greenish brown tint to the tissue.

Upon the exterior of the diseased area are often found, though sometimes in limited numbers, together with an occasional olive conidium, delicate hyaline spores borne on aërial hyphæ. So far the hyaline spores have not been seen in progress of formation within the tissue of the potato, but upon the blackened sprouts as they are grown in the hotbed they are present in abundance, arising from the tips of elongated hyphæ.

A third form of the fungus shows itself both upon sprout and root in the shape of flask-like pycnidia with elongated beaks or necks fimbriated at the apex. Often the globular bodies of the pycnidia are buried in the tissue of the potato, and only the slender necks are visible above the surface, giving it a bristly appearance.

Where specimens covered with pycnidia are protected from the rains the pycnospores collect in a more or less firmly united mass at the apex of the neck, and the fimbriations seem to serve the purpose of a basket for the mass. The appearance of the fimbriated slender necks and surmounting yellow globules is very characteristic.

Although not certainly connected with the species of fungus causing the black rot there have been found, often in badly diseased specimens, immense numbers of globular sclerotia differing in structure from those of many other species but surrounded by and evidently made up of hyphæ identical with those of this species. These sclerotia were found in all stages of formation and in the last stages in such abundance as to entirely fill the tissue of the diseased potato, causing it to become gray and finally charcoal black.

DESCRIPTION OF CULTURES.

The growth of this parasite upon underground stems composed largely of carbohydrates suggested the idea of cultivating it upon artificial media. In doing this, numerous points of interest were brought

* Die Zersetzungserscheinungen des Holzes 1878, Berlin, Die Lehrbuch der Baumkrankheiten.

out and the structure and development of the fungus were much more easily studied than on the host itself.

A medium composed of a 1 per cent solution of agar-agar in sweet potato broth was the most satisfactory. This was made by adding to 4 grams of agar steeped for 5 hours in 300 cubic centimetres of water 100 cubic centimetres of sweet potato broth. The sweet potato broth was not essentially different from ordinary potato broth, and was made by steeping the slices from one large potato for several hours in enough water to cover them. This medium was used both in the form of plate and slanting test-tube cultures, but proved most satisfactory in the latter on account of the ease with which the tubes were handled.

Besides the sweet potato agar upon which the main study of the fungus was made, several other media were tried. Slices of sweet potato cooked and uncooked in test tubes, similar slices of Irish potato, and *nahrlosung* agar made by adding 2 grams of agar to 200 cubic centimetres of a strong decoction of fresh horse dung, were used, but showed no special points of interest. Ordinary potato broth proved entirely successful and did not reveal the presence, in this species, of sprouting or yeast forms. The fact that sections of the white pine taken from living trees and first sterilized in test tubes by intermittent boiling, grew the parasite in profusion is at least suggestive. Sections from the willow similarly treated failed to nourish the fungus.

Because of the difficulty of obtaining conidia of the fungus with which to start the growth in the hardened culture media the inoculations of sterile media were started from the mycelium itself. Small particles of the diseased tissue were carefully removed with a glass hook from the border line between the healthy and diseased portions of the potato, and sufficiently deep beneath the surface of the skin to render contamination improbable. These particles were at once inserted into the media and almost without exception produced a pure growth of the fungus. Around portions of tissue thus inserted appear in 24 hours the radiating mycelial hyphæ, and in a few days the first form of conidia. After the appearance of the first or hyaline conidia upon the surface of the culture, inoculations with the pure spores were at once made upon the various media above referred to. The cultures grew with great rapidity and maintained their vitality for months. Inoculations made on May 26 from tubes started March 18 show the pycnospores to be still alive.

Van Tieghem cells and hanging drop cultures were employed to ascertain a number of the details of growth and by the use of sweet potato agar in hanging drops on the under side of cover glasses, the growth of certain pycnidia was satisfactorily followed from day to day.

Three days after sowing pure conidia upon sweet potato agar an abundant thallus is formed which has a number of characteristic features

Mycelium.—The hyphæ rapidly penetrate the artificial substratum, giving it a dark appearance by their presence. They are 2 – 6 μ in diameter, with frequent septa, and filled with oil globules, which give them a guttulate appearance. The globules are present in such quantities that they issue from the broken hyphæ tips under the cover glass and rise to the surface in large numbers. They give the characteristic reaction with osmic acid, are present in natural as well as artificial media, and seem to be more abundant and of larger size in half starved portions than in rapidly growing parts, as noticed by Naegeli* and Cunningham† in various species of fungi.

Simultaneously with the downward growth of the hyphæ into the substratum there rise to the surface specialized branches, which perform the office of sporophores. These long, multiseptate branches, which we may term the primary sporophores, are 60–160μ long by 6–7μ in greatest diameter, generally somewhat fusiform in shape, and with the exception of the lighter colored tips, which reach the surface of the medium, are of the greenish brown color of the remainder of the thallus.

Hyaline, or microconidia.—From the slightly colored tips of these sporophores hyaline conidia are produced immediately after they arrive at the surface of the substratum. These hyaline conidia correspond in a measure to the micro-conidia of *Nectria* and *Hyphomyces*, but owing to the impropriety in the use of the term pointed out by Reinke and Berthold,‡ the term hyaline will be used to avoid ambiguity.

The method of spore formation by which these conidia are produced resembles quite closely that observed by Unger§ in the case of *Graphium penicilloides*, Corda, now called *Chalara Ungeri*, Sacc., and in a less degree that of the new genus *Endoconidium* recently described and figured by Prillieux and Delacroix in the last fascicle of the Bulletin de la Société Mycologique de France.‖ In regard to the spore formation of *Chalara Ungeri*, Sacc., found growing on pine and fir timber in the forests of Austria, Unger remarks: §

> Upon still greater magnification (Fig. 4) it is seen that the brown apices are only the sheaths of fine cylindrical cells from which terminal segments, bound together in a thread-like manner, are abjointed and pushed out. There is no doubt that these latter have the significance of brood cells, although they possess a great similarity to the spores of certain species of *Torula*.

The figure given by Unger represents quite plainly the abjunction of the conidium *within the end* of the hypha in a manner precisely similar to that shown in Plate II, Fig. 1. It differs, however, from the other

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* Sitzungsberichte der K. Akademie zu München, 1879.

† Quarterly Journal Microscopical Society, XX, 1880.

‡ Reinke and Berthold, Die Zersetzung der Kartoffeln durch Pilze, 1879.

§ Botanische Zeitung, 1847, Nr. 15, T. IV.

‖ Prillieux and Delacroix, *Endoconidium temulentum*, nov. gen. nov. spec. Champignon donnant au seigle des propriétés vénéneuses. Bulletin de la Société Mycologique de France, Tome VII, 2e Fascicule, p. 116.

species of *Chalara* as figured by Saccardo* and Corda,† in which the spores are represented as being abjointed, not at one but at various points within the sheath-like hyphæ‡ as in the case of *Sporoschisma mirabile*, B. & Br.; § *Bloxamia truncata*, B. & Br.; || *Thielavia basicola*, Zopf.; ¶ *Aphanomyces stellatus*, DBy.,** and probably, although it has not been possible to examine figures, *Trullula nitidula*, Sacc.††

When the conidiophore has reached the limit of its growth the outer cell wall of the tip and the portion immediately below it ceases growing and becomes slightly tinted olive color like the mycelium. The protoplasm contained between the last septum and the apex continues to grow and ruptures or absorbs the cell wall of the tip, pushing out, seemingly as a naked protuberance of the protoplasmic contents of the cell, but probably clothing itself with an extremely thin membrane, leaving behind the sharply defined broken edge of the conidiophore. After growth has continued for a few minutes and the cylindrical protrusion has attained about the length of the diameter of the sporophore, a septum forms below the mouth of the sporophore and by the further growth of the protoplasmic contents of the mother cell the fully formed gonidium is pushed out from the sporophore only to be followed by a second spore in the same way. Fifty to sixty of these spores are frequently thus shoved out of a single vigorous sporophore, varying from one-half to one hour each in time of appearance. These hyaline conidia remained attached to each other in long chains, often doubling upon themselves in Van Tieghem cell cultures and forming several rows upon the moist underside of the cover glass (Plate II, Fig. 1).

It is surprising that in such a work as that by Dr. Alexander Zalewski, *Ueber Sporenabschnurung und Sporenabfallen bei den Pilzen*, published in 1883,‡‡ no mention should be made of such a striking modification of the author's second type of spore formation, called *Succedane reihenweise*

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* Saccardo, Fungi Italici, Figs. 29, 30, 31, 32, 35.

† Corda, Icones Fungorum, T. II, p. 9, Tab. IX, Fig. 43.

‡ Mr. J. B. Ellis and Dr. H. W. Harkness have kindly allowed the examination of *Chalara acuaria*, C. & E., and *Chalara brachyspora*, Sacc., in which the spores are borne apparently as in *Chalara Ungeri*, Sacc., by abjunction from an elongated mother cell, if the term may properly be applied to such cell with power of continuous conidia formation.

§ Berkeley, M. J. and Broome, C. E. Notices of British Fungi XL in Annals and Magazine of Natural History, June, 1850, S. 2, Vol. 5, pp. 23, 24 (same in reprint). Reference made to *Graphium penicilloides* l. c., Int. Crypt. Bot., p. 327, Fig. 74; Montaigne, Sylloge Generum Spec. Crypt., 1856, p. 306; Fresenius, Beitr. z. Mykologie, 1852. p. 17, T. VI, Fig. 26, 27, 28.

|| Ann. Nat. Hist., 1854, p. 468, T. XVI, Fig. 17. Berkeley, Int. Crypt. Bot., p. 327, Fig. 74 b.

¶ Winter, Die Pilze, Bd. I, Abth. II, p. 44; Zopf, Die Pilze, 1891, Fig. 61, p. 97; Zopf, Über die Wurzelbräune der Lupinen, eine neue Pilzkrankheit, in Zeitschrift für Pflanzenkrankheiten, Band I, Heft 2, 1891, pp. 72–76.

** Pringsheim's Jahrbücher, II, p. 170, T. XIX, Figs. 1–3; Linstedt K. Synopsis d. Saprolegniaceen, p. 63.

†† Saccardo, Michelia, II, p. 235; Sylloge Fungorum, III, p. 732.

‡‡ Flora, 1883, p. 228; Polish Inaugural Dissertation, 1883. Also in German.

Abschnurung der Sporen auf dem Scheitel der Basidie, especially after the publication in 1847 of such perspicuous figures as those of Unger's above referred to. Although not mentioned by De Bary, this method of spore abjunction is referred to by Zopf in his recent work.

The fully formed spores are thin-walled, hyaline, 16–30 by 4–9μ, bacillary, and sometimes oblong or clavate. They germinate in a few hours in water or nutrient solutions, and quite generally form a protuberance near the medial zone, exactly opposite to the germ hypha, thus giving the germinating spore the form of a cross (Pl. II, Fig. 4). The slender germ hyphæ produce sporophores, often immediately, and these push out from their apices conidia similar in all respects to the original ones (Fig. 4), and the secondary or olive conidia form on more irregular branches (Pl. II, Fig. 5).

Olive or macro conidia.—The second mode of spore formation, which in all essentials resembles the first, takes place, in cultures, following the first, and were it not for its slower movement would be entirely simultaneous with it. Unlike the hyaline spores which are produced upon the surface of the medium, the olive conidia are formed generally deeply buried within the tissues, showing no inclination to rise into the air. The sporophores which bear them consist of simple, septate, branching hyphæ, frequently almost indistinguishable from the primary conidiophores above mentioned, and also from the sterile branches of the mycelium. The mode of spore formation differs from that just described for the hyaline conidia only in tardiness of movement and such other points as the difference in shape of the olive conidia would necessitate; in fact, the two may be said to merge into each other, the primary conidiophores producing spores resembling the olive conidia in shape and *vice versa* (Cf. Pl. II, 2 a, 5 a). Normally, the first olive conidium produced differs from those which follow in being oblong-ovate, while the succeeding ones are globose or elliptical with a small pedicel or extension at the lower extremity (Figs. 5, 6). That these conidia are produced in a manner not wholly in accordance with that described by De Bary * is demonstrated by the fact that the tip of the sporophore is ruptured, as in the formation of the hyaline conidia, upon the formation of the first spore and displays from the beginning of the spore formation (Fig. 8 *a*) until the complete abjunction of the mature spore (Fig. 8*c*) a distinct somewhat irregular edge or rim, below which is formed the true septum of the conidium (Fig. 8). In older specimens, after four or even five (the maximum number observed) conidia have been pushed out, the protoplasm below the last formed septum often becomes rounded as at Fig. 6, Plate II, clearly demonstrating that the delicate exospore of the conidium is formed within the surrounding end of the sporophore. These olive conidia are 12–19 by 6–13μ, mostly 10–11 by 12–15μ, and in the first stages of their formation are hyaline, thin-walled bodies with more or less evenly granular contents. In the

* De Bary, Morph. and Biology of the Fungi, Eng. edition, p. 69–70.

† Zopf, Die Pilze, 1890, p. 97.

course of 24 hours they become dark colored and coarsely granular, later developing numerous oil globules which react strongly with osmic acid, giving the characteristic brown color. Occasional specimens among hundreds observed manifested a tendency to germinate either in nutrient solutions or water, and those noted sent out long hyaline branching hyphæ. These were not followed to the production of secondary sporidia. From analogy the olive conidia may be expected to serve the purpose of resting spores, possessing thick exospores and being formed largely within the soft tissues of the potato.

Pycnidia.—From a week to 9 days after sowing the hyaline conidia, a third form of fructification makes its appearance, developing with remarkable rapidity and abundance. In its initial stages the pycnidium arises as the swollen and curled or twisted tip of a vegetative hypha, or as a twist or knot in a sporophore between the conidium and its point of union with the main hypha (Plate III, Fig. 9). Although observed to be present in numerous cases, no anastomosing of different hyphæ branches seems necessary. Almost simultaneously with the first curving of the hypha tip, side branches arise which, by their growth and formation of septa, form the coarsely cellular membranaceous wall of the pycnidium. After the globose base of the pycnidium has attained its normal diameter, there arises an elongated ostiolium or beak, composed of slender septate hyphæ placed parallel, side by side, in several ranks about the orifice. By the rapid extension of these hyphæ, a long, hollow neck or beak is formed for the upward passage of the pycnospores. When the neck-forming hyphæ have reached their limit of extension, the tips become gradually tapering and form, upon maturity, long (30–60μ) slender hyaline fimbriations. Both the bulbous portions of the pycnidia and the slender necks vary greatly in size, the former being 96–224 by 96–224μ in diameter, and the latter 395–608μ long by 24–34μ at base and 14–20μ at apex.

Pycnospores.—So far as the extremely fragile nature of the interior permitted observation, the pycnospores are formed by the division of very thin-walled mother cells lining the cavity of the pycnidium. Until means can be devised for removing the difficulties lying in the way of the determination of this point, the exact mode of formation must remain in doubt. The pycnospores are hyaline, globose, or oblong, and are fastened together by a mass of refringent substance tardily soluble in water. When freshly exuded from the tip of the pycnidium, they are 5–9 by 5–9μ; but, upon immersion in water for several hours, they swell greatly, becoming 12–17 by 9–15μ. In culture media, both while remaining closely united in masses and when separated, they germinate profusely, producing upon their frequently anastomosing hyphæ, both hyaline and olive conidia, and finally pycnidia, similar to those in which they are produced. The presence of the gelatinous substance uniting the conidia, manifests itself upon the germination of the spore as a granular film, which assumes (as at Fig 4*b*, Plate III) the form of a delicate ring, often of narrow, lateral extension.

INOCULATIONS.

Healthy potatoes, kept in a moist atmosphere in the laboratory, upon being covered with the hyaline conidia and pycnospores of the fungus, became, in the course of a few weeks, badly diseased with the typical black rot. The fungus is capable of entering the eyes of the potato and is nourished by the small, dead fibrils often connected with the eyes. In inoculations, the diseased portions began in or near the eye. To convince the most skeptical, initials were scratched upon the surface of one potato with a sterile needle, and the surface coated with hyaline conidia in water. In three weeks the initials appeared in typical black-rot lines against the brown back ground.

PROBABLE LIFE HISTORY.

The life cycle of the parasite, although not certainly completed by these different forms, may cover a period of several weeks and perhaps months. The abundant mycelium present in the diseased roots planted in the hotbed for the purpose of obtaining sprouts infects the young shoots as described. This infection may take place either through the medium of spores or by the growth of mycelium from the diseased areas themselves. Diseased sprouts planted in the field produce diseased roots which may spread the disease to other hills either through the soil directly or by means of the numerous fibrils from other plants. These infected areas, although perhaps inconspicuous at first, grow steadily in diameter not being checked by digging, and when the potatoes are stored for keeping continue to grow in the root and at the same time to produce the various forms of spores. These reproductive bodies when supplied with sufficient moisture are capable of infecting, unaided, sound potatoes through their eyes. Thus one diseased potato when stored in a bin of healthy ones is capable of infecting all those in the bin and causing them to rot in a short time.

To what extent the fungus is able to live upon the dead vegetable matter of the soil has not been determined, but from its omnivorous habits numerous substances might be expected to nourish it in an active state. The fact that the parasite grows luxuriantly upon strong *nahrlosung* agar would perhaps indicate its ability to inhabit different stable manures applied to the potato fields, and although no experiments were attempted to show whether a passage through the digestive canal would kill the spores, circumstantial evidence points strongly to the belief that such passage does not destroy all forms.

Ceratocystis fimbriata probably winters not only in the roots used for seed the following spring, but in the soil itself, upon decaying portions of sweet potato roots and other vegetable substances. The sclerotial stage mentioned may be found to compose the principal resting stage of the parasite.

PREVENTIVE MEASURES.

I. The first and most important precaution to be taken in combating the disease is to plant only perfectly healthy seed in the hotbed, even

if it is necessary to import such. This preventive measure is most essential, as diseased seed will give diseased sprouts, which in turn will grow a crop of worthless potatoes.

II. The selection of healthy sprouts is plainly necessary in case the fungus gets into the hotbeds, and under no circumstances should diseased plants be put into the field. The test of using copper fungicides in the hotbed has not been made, but from analogy seems to promise assistance. If the fungicide is used the shoots should be kept green with it until pulled.

III. Fields which have become so impregnated by the disease that they refuse to grow profitable crops had best be added to the regular farm rotation. This method will, if continued for several years, allow the accumulated infective material to burn itself out by consuming all available food material in the soil.

IV. Decaying roots and the refuse after digging should be carefully removed from the field and burned, as such débris adds to the food of the parasite.

V. The use of large quantities of barnyard manure probably favors the development of the trouble, since it adds greatly to the decaying vegetable matter of the soil. Where the use of commercial fertilizers can be made to take the place of manure it will certainly be desirable to make the change.

VI. Although no experiments have yet been completed upon the matter, it is probable the spread of the disease in the bin may be checked by dipping the roots in one of the copper mixtures, preferably the ammoniacal solution, before storing for the winter. What effect tobacco smoke or the fumes of sulphur would have in checking the disease in the bins remains to be ascertained.

Experiments are now under way to ascertain, if possible, the effect of the use of the ammoniacal solution of copper carbonate in preventing the disease. Hotbed, field, and bin experiments are in progress, and it is hoped definite results will be obtained.

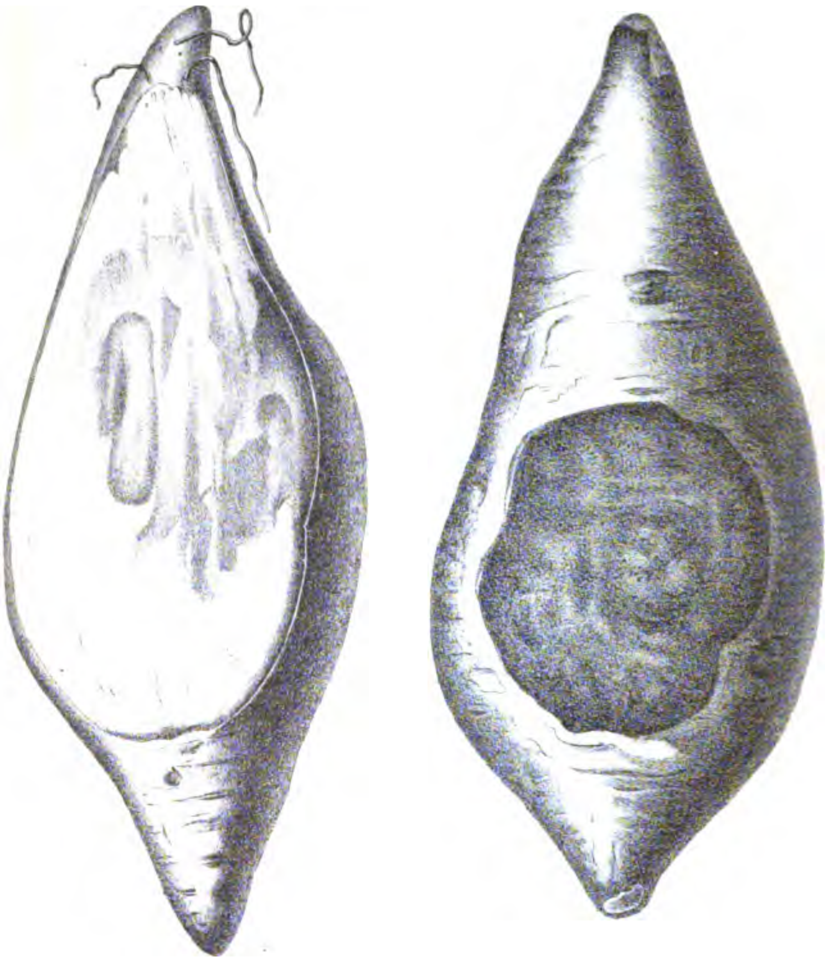
SUMMARY.

I. The black rot of the sweet potato, both upon young shoots, causing "black shank," and upon mature roots, is caused by the parasitic action of the fungus *Ceratocystis fimbriata*, Ellis and Halsted.

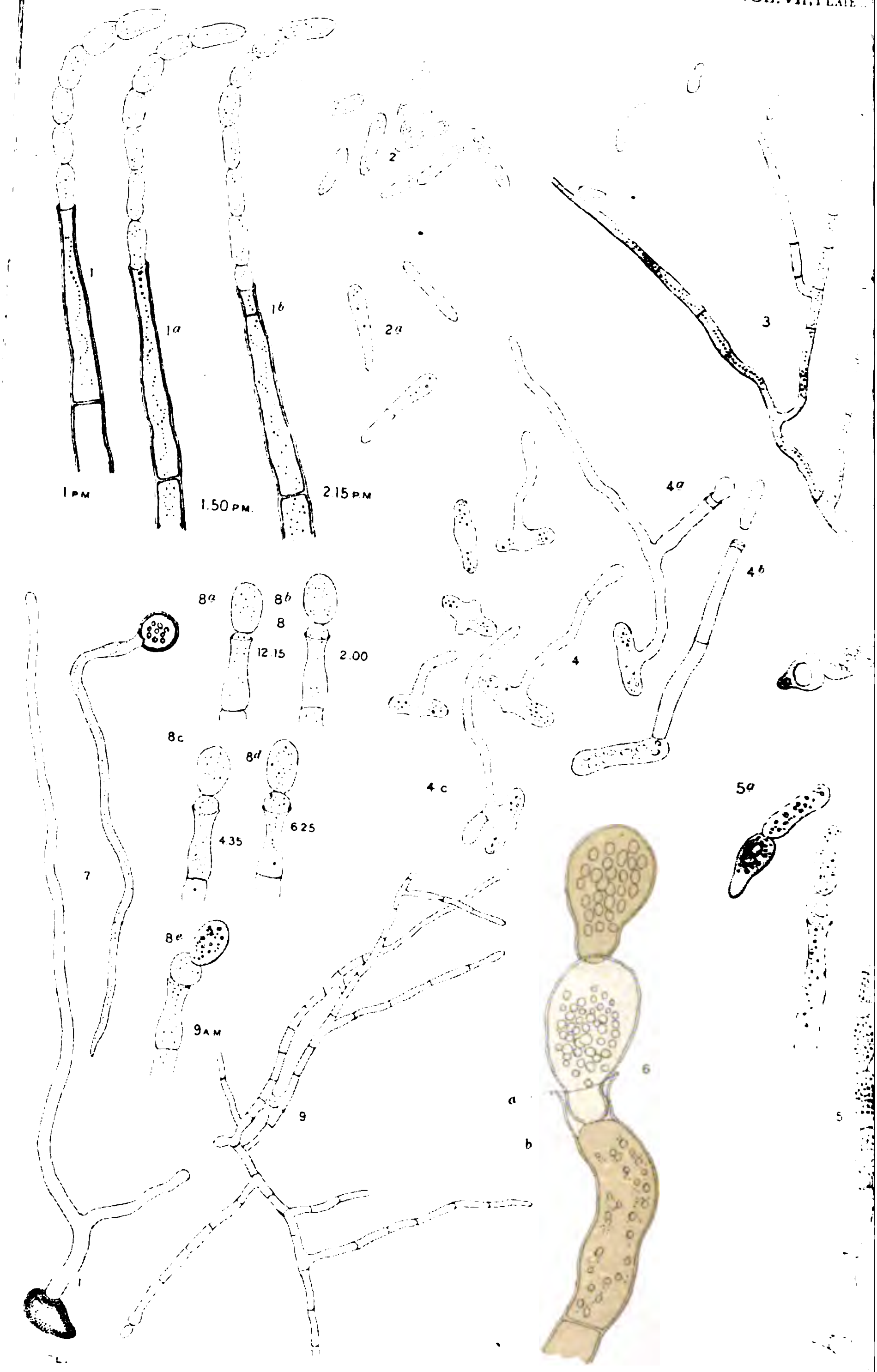
II. Portions of diseased tissue develop, when placed upon various media, abundant growths of the parasitic fungus.

III. Three modes of spore formation are present, two endogenous from the tips of specialized hyphæ, the third from cyst-like bodies. The connection of a sclerotial form, although not demonstrated by culture, is strongly suspected.

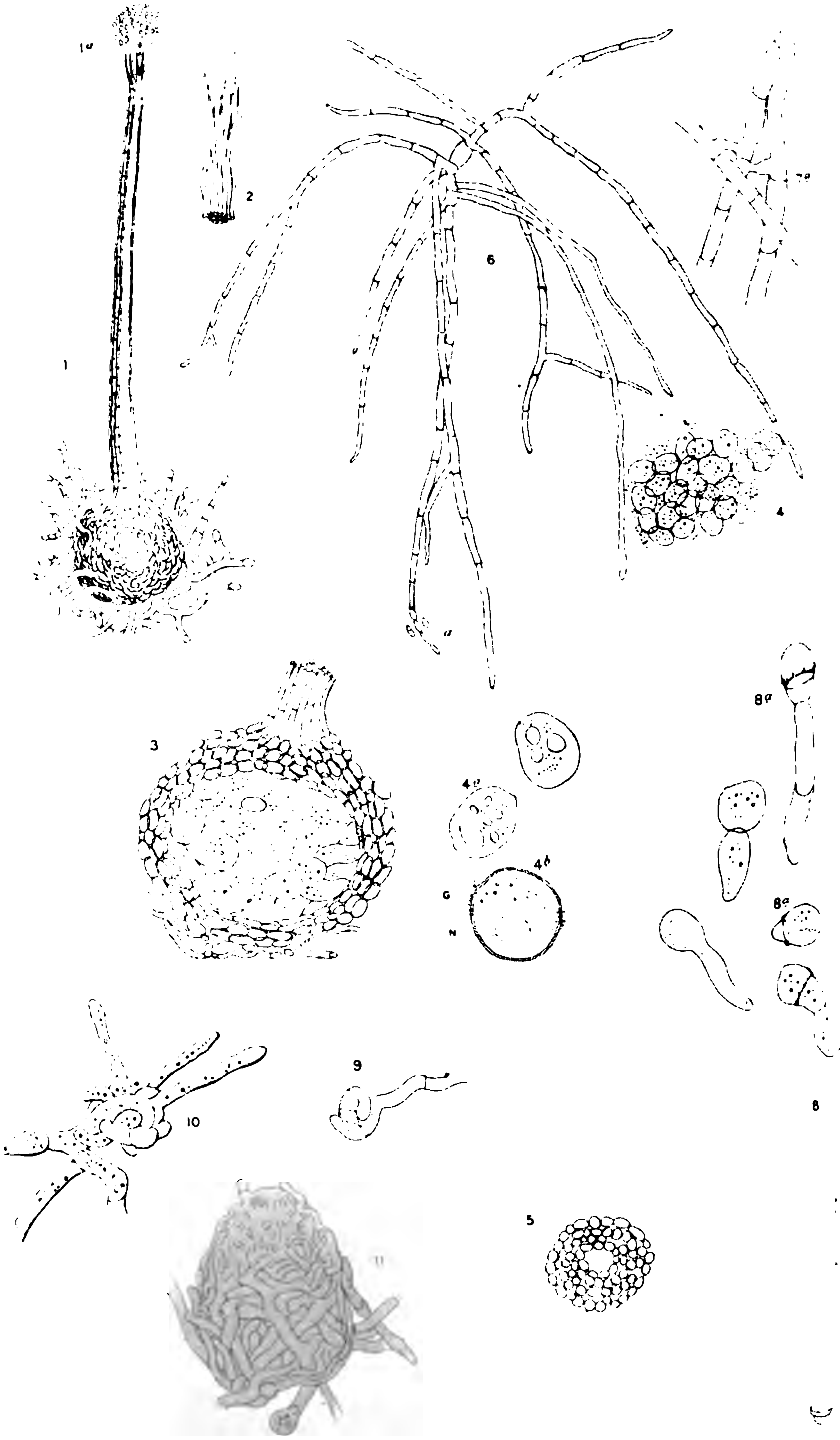
IV. Spores grown in cultures are capable of inoculating healthy roots through the broken cuticle or through the eyes.



HALSTED AND FAIRCHILD ON SWEET POTATO BLACK ROT.



HALSTED AND FAIRCHILD ON SWEET POTATO BLACK ROT.



HALSTED AND FAIRCHILD ON SWEET POTATO BLACK ROT.

DESCRIPTION OF PLATES.

PLATE I, *Ceratocystis fimbriata*, Ell. & Hals.

Fig. 1. Sweet Potato showing blackened area, inhabited by the parasite.
2. Cross section of the same.

PLATE II, *Ceratocystis fimbriata*, Ell. & Hals.

Fig. 1. Sporophore of hyaline conidia figured 1 p. m. *1a*, the same figured 1:50 p. m. *1b*, the same at 2:15 p. m. × 550. From test-tube cultures of sweet potato agar-agar.
2. Group of hyaline conidia, showing variations in form from test-tube culture. *2a*, the same from plate culture × 400.
3. Group of hyaline conidia sporophores, showing spore formation × 300. From test-tube cultures.
4. Germinating hyaline conidia from cultures 24–48 hours old in sweet potato agar. *4a*, young germ hypha with hyaline conidium forming. *4b*, hyaline conidium lately expelled from sporophore. *4c*, commencement of sporophore or branch of hypha of germination × 550.
5. Sporophores with olive conidia issuing from tips. *5a*, characteristic primary spore first formed × 550.
6. Sporophore of olive conidium greatly enlarged × 1,500. *a*, ruptured outer wall of sporophore. *b*, protoplasmic contents of mother cell.
7. Olive conidia germinating × 550.
8. Successive stages in formation of olive conidia. *8a*, sporophore and spore figured 12:15 p. m. *8b*, same 2 p. m. *8c*, same 4:35 p. m. *8d*, same 6:25 p. m. *8e*, 9 a. m.
9. Primary growth of mycelial hyphæ from hyaline conidium.

PLATE III, *Ceratocystis fimbriata*, Ell. & Hals.

Fig. 1. Mature pycnidium × 200. *1a*, gelatinous mass of exuded spores.
2. Fimbriate tip of beak or ostiolium × 500.
3. Cross section of pycnidium showing large thin walled cells, previous to spore formation × 300.
4. Gelatinous mass of pycnospores × 550. *4a* isolated spores shortly after immersion in iodine. *4b* pycnospore after 48 hours in sweet potato agar culture. *N*, nucleus; *G*, ring of gelatinous granules.
5. Cross section of pycnidium beak near base × 550.
6. Primary growth of mycelial hyphæ from pycnospore × 200.
7. Anastomosing hyphæ abundant on mycelium from pycnospores and hyaline conidia × 440.
8. Germinating pycnospores. *8a* ring of gelatinous uniting substance. *8b* promycelium in form of a sporophore with hyaline conidium issuing × 550.
9. Primary stage in development of pycnidium × 550.
10. Early stage in development of pycnidium × 550.
11. Immature pycnidium × 400.

EXPERIMENTS IN THE TREATMENT OF PLANT DISEASES.

By B. T. GALLOWAY.

(Plate IV.)

PART III.

In addition to the field work conducted in 1890 by the Division of Vegetable Pathology and set forth in Parts I and II of this article, a series of experiments were made under our direction by field agents located in various parts of the Union. The reports of these agents have all been received, and while it is our usual custom to publish them in the form of a special bulletin several reasons make it more desirable to give them in a condensed form here.

TREATMENT OF GRAPE DISEASES.

These experiments were carried on at Greenville, South Carolina; Vineland, New Jersey; and Neosho, Missouri. The work in the main was planned to throw additional light on the treatment of black rot, which is everywhere recognized as being the most destructive of all grape maladies. The questions we were desirous of obtaining more information upon may be briefly summarized as follows:

I. A comparison of the fungicides given below as regards cost, efficiency, and effects on the healthy foliage and fruit.

(*a*) Bordeaux mixture prepared in accordance with the usual formula, *i. e.*, copper sulphate 6 pounds, lime 4 pounds, and water 22 gallons.

(*b*) Bordeaux mixture prepared the same as *a*, then allowed to settle. After this has taken place drawing off the clear liquid and drying the sediment the latter being simply mixed with water when used. The object in using this preparation was to determine if possible whether the Bordeaux mixture prepared in advance was as effective as that made in the usual way. The question has considerable practical importance as there is an increasing demand for a mixture ready for use. This demand is mostly from small growers who do not care to go to the trouble of buying the copper and lime and making their own mixture.

(*c*) Modified eau celeste containing copper sulphate 4 pounds, aqua ammonia 3 pints, carbonate of soda 5 pounds.

(*d*) Copper carbonate in suspension, 3 ounces to 22 gallons. This being a much cheaper preparation than the ammoniacal copper carbonate solution, it was thought best to give it a thorough trial.

(*e*) Simple milk of lime made by dissolving 3 pounds of lime in 25 gallons of water.

(*f*) Solution of copper acetate, 2 pounds to 22 gallons.

(*g*) Mixture No. 5 consisting of equal parts of ammoniated copper sulphate and ammonia carbonate. Used at the rate of 1 pound to

25 gallons of water. Mixture No. 5 is practically eau celeste in dry concentrated form.

(*h*) Ammoniacal copper carbonate solution, 3 ounces copper carbonate dissolved in 1 quart of ammonia, and diluted with 22 gallons of water.

II. The value of a mixed treatment, consisting of three early treatments of the Bordeaux mixture and three late sprayings of the ammoniacal solution.

III. The value of early against late sprayings. By early is meant the first treatment when the buds begin to swell, and by late the first treatment when the grapes are the size of bird shot.

EXPERIMENTS AT GREENVILLE, SOUTH CAROLINA.

The work at this place was conducted A. M. Howell, who is to be commended for the care devoted to it. The vineyard chosen by Mr. Howell for the experiment was one which had been well cultivated and cleared, but had never before received any treatment for vine diseases and for 3 years had regularly lost from 50 to 75 per cent of its crop by black rot. Besides this it had been invaded by downy mildew and anthracnose.

The variety selected for experimental treatment was the Concord, because of its regular habits of growth and fruitage, and its unvarying susceptibility to rot. In accordance with instructions the vineyard was divided into 14 contiguous plats, 11 consisting of 58 and 3 of 50 vines each. In the 11 plats, containing 58 vines each, a sub-plat of 8 vines was marked off in the center of each. These sub-plats were left without treatment. The vineyard was then divided as follows: Three plats of 50 vines each, containing no sub-plats; eleven main plats containing 50 vines each having in the center a sub-plat of 8 vines each. The different plats were designated by the letters of the alphabet from A to W, inclusive, as shown in the following diagram:

A	B	A
C	D	C
E	F	E
G	H	G
I	J	I
K	L	K
M	N	M
O	P	O
Q	R	Q
S	T	S
S	T	S
U		U
V		V
W		W

FIG. 1.

The variation in regard to these was for the purpose of bringing out the value of early spraying, as will be shown later.

The first spraying was made 10 days before blooming, and would have been applied earlier but for a delay in the arrival of some of the chemicals. The weather had been dry for 2 weeks and no disease was showing on the leaves. The next day, however, a rainy spell set in, lasting 5 days. The second treatment was also given on a clear day and the first traces of black rot had been discovered the day before. There were rains on May 18, 19, 20, and then none until June 1. The day after the fourth treatment there was a light rain (June 15) and this was followed by a drought which put an end to any infection of black rot for the season.

In order to get a fair estimate as to the value of the various treatments the diseased and healthy berries on both the treated and untreated plats were carefully counted and weighed. The weight of diseased fruit was estimated by counting, in several cases, the number of berries in a pound of sound fruit, obtaining an average number, and dividing the number of diseased berries by it. The results of this work is shown in tabular form below.

Plat.	Number of vines, date, and manner of treatment.	Yield of sound fruit per plat.	Average yield per vine.	Number of rotten berries per plat.	Number of rotten berries per vine.	Total rot per plat in pounds of sound fruit.	Percentage of loss.	Total cost of treatment
		Pounds.	*Pounds.*					*Cents*
A....	50 vines treated April 30, May 15 and 30, and June 14, with Bordeaux mixture........	260	5.20	275	5.50	1.56	.6	.54
B....	8 untreated vines........	23	2.87	2,464	308	14	38	.00
C....	50 vines treated April 30, May 15 and 30, and June 14, with ammoniacal copper carbonate solution..............	255	5.10	236	4.72	1.34	.6	.22
D....	8 untreated vines........	20	2.50	2,816	352	16	45	.00
E....	50 vines treated April 30, May 15 and 30, and June 14, with Bordeaux mixture and ammoniacal solution......	255	5.10	188	3.76	1.06	.4	.40
F....	8 untreated vines........	20	2.50	2,827	353	16	45	.00
G....	50 vines treated April 30, May 15 and 30, and June 14, with modified eau celeste............	260	5.20	68	1.36	.33	.1	Not given.
H....	8 untreated vines........	24	3	2,466	308	14	37	.00
I.....	50 vines treated April 30, May 15 and 30, and June 14, with copper carbonate in suspension........	246	4.92	268	5.36	1.52	.6	.11
J....	8 untreated vines........	18	2.25	2,998	375	17	48	.00
K....	50 vines treated April 30, May 15 and 30, and June 14, with milk of lime..................	190	3.80	8,599	172	48.86	20	.03
L....	8 untreated vines........	20	2.50	2,819	352	16	45	.00
M....	50 vines treated April 30, May 15 and 30, and June 14, with Bordeaux mixture prepared in advance..............	230	4.60	367	7.34	2.08	.9	.54
N....	8 untreated vines........	22	2.75	2,126	266	12	35	.00
O....	50 vines treated April 30, May 15 and 30, and June 14, with Bordeaux mixture, one-half strength prepared in advance..............	180	3.60	8,730	174.60	49.60	21.50	.27
P....	8 untreated vines........	17	2.12	2,872	284	13	43	.00

Plat.	Number of vines, date, and manner of treatment.	Yield of sound fruit per plat.	Average yield per vine.	Number of rotten berries per plat.	Number of rotten berries per vine.	Total rot per plat in pounds of sound fruit.	Percentage of loss.	Total cost of treatments.
		Pounds.	*Pounds.*					*Cents.*
Q....	50 vines treated April 30, May 15 and 30, and June 14, with acetate of copper solution......	260	5.20	277	5.54	1.57	.6	Not given.
R....	8 untreated vines........	20	2.50	2,176	272	12	37.50	.00
S....	50 vines treated April 30, May 15 and 30, and June 14 with mixture No. 5................	255	5.10	113	2.23	.63	.25	Not given.
T....	8 untreated vines........	25	3.12	2,472	309	14	36	.00
S'....	50 vines treated April 30, May 15 and 30, and June 14 with mixture No. 5	216	4.32	312	6.24	1.77	.8	Not given.
T'...	8 untreated vines........	22	2.75	2,287	286	13	37	.00
U....	50 vines treated May 17 and June 2 with Bordeaux mixture; late treatment..............	210	4.20	2,112	42.24	12	5	.22
V....	50 vines treated May 25, June 9, with Bordeaux mixture, 8 days later than U..............	200	4	2,040	40.80	11.59	5.50	.27
W ...	50 vines treated May 17 and June 2 same as U, excepting ammoniacal solution was used......	220	4.40	2,618	52.36	15	6	.11

Very little comment upon the foregoing table is necessary, as we believe it fully explains itself and in a measure answers the questions summarized in the first part of this article. It will be seen that seven of the fungicides used reduced the amount of rot to less than 1 per cent, while on the untreated vines the loss averaged 40 per cent. This was much less than in an ordinary season, on account of the dry weather. In such cases about 75 per cent would have probably been lost. The present season was not one either that furnished a good test of fungicides. If more rain had fallen there is little doubt that there would have been more rot on the treated plats, more striking differences in the degrees of efficacy of the different fungicides, and more grapes actually saved. That is, the difference between the amount lost on the treated and untreated plats would have been much greater.

As to the comparative value of the fungicides, the ratios found in the figures as given can scarcely be considered such as will hold for other seasons and in different climates. This season's work has shown that a difference in locality affects the action of fungicides on foliage; for example, the copper acetate, which proved very efficacious with Mr. Howell, of South Carolina, burned the foliage so badly in Missouri as to ruin the crop for the year.

Milk of lime and precipitated Bordeaux mixture, one-half strength, both proved ineffectual. As regards efficiency the other fungicides stood in the following order:

Modified eau celeste.
Mixture No. 5.
Bordeaux mixture and ammoniacal solution.
Bordeaux mixture.
Copper acetate.
Ammoniacal solution.
Copper carbonate in suspension.
Precipitated Bordeaux.

The loss from not beginning the treatments early was not as striking as was anticipated, but there is no doubt that a wet spring would have shown a more decided contrast between the effects of late and early treatments. As it was, a difference of 8 days in the date of the first application made a difference of 5 per cent in the amount of rot, showing that it is not safe to begin treatments later than the last of April in the Southern grape-growing districts, or, in general, about 10 days before the blooming.

EXPERIMENTS AT CHARLOTTESVILLE, VIRGINIA; VINELAND, NEW JERSEY; AND NEOSHO, MISSOURI.

The experiments at the foregoing places cover practically the same ground as those given in detail in the preceding notes; in fact, the same plan was followed at each place. Without going into further details, for which we have not space here, the entire work may be summarized as follows:

I. All things considered, the Bordeaux mixture still heads the list as a preventive of black rot.

II. The Bordeaux mixture prepared in advance according to the directions already given is not satisfactory, and is therefore not worthy of further use.

III. Copper carbonate in suspension and milk of lime are comparatively useless as preventives of black rot and other grape diseases.

IV. Copper acetate has fungicidal value, but in most sections it is likely to injure the foliage.

V. The cheapest and most effectual remedy for black rot and downy mildew, taking everything into consideration, is the ammoniacal solution of copper carbonate. Next to this is a mixed treatment consisting of two or three early sprayings of Bordeaux mixture and the same number of late treatments with ammoniacal solution.

VI. Mixture No. 5, while possessing value as a fungicide, is likely to injure the foliage. Until this difficulty is overcome its use on a large scale can not be recommended.

VII. Early sprayings are absolutely necessary to insure the best results in the treatment of black rot.

As heretofore, experiments in the treatment of a number of plant diseases were carried on under our direction in Wisconsin by Prof. E. S. Goff, of the State Experiment Station. Following is Professor Goff's report in full.

TREATMENT OF FUNGOUS DISEASES.

REPORT OF E. S. GOFF, MADISON, WISCONSIN.

SIR: I have the honor to report the results of experimental work in the treatment of certain fungous diseases of plants as per plan approved by you in May last.

E. S. GOFF,
Special Agent, Madison, Wisconsin.

Mr. B. T. GALLOWAY,
Chief of the Division of Vegetable Pathology,
U. S. Department of Agriculture.

The fruit farm of Mr. A. L. Hatch, on which the experiments here reported were conducted, lies 3½ miles southeast of the village of Ithaca, Richland County, Wisconsin. It crowns the summit of a hillock, and is not far from 1,000 feet above sea level. The soil is a light clay loam, underlaid by Potsdam Sandstone, and is in a good state of cultivation.

The plan of work arranged included treatment for the apple scab, *Fusicladium dendriticum*, Fckl., the Septoria of the raspberry and blackberry, *Septoria rubi*, West, and the potato rot. The weather during the early summer, however, proved excessively rainy,* and the effects of some of the applications were undoubtedly destroyed by copious showers soon after the treatments. It was sometimes necessary to postpone applications from day to day owing to the very frequent rains. The somewhat meager results secured in the treatment of apple scab, as compared with the season of 1889, are probably attributable to the excessive rainfall of the early part of the summer.

In all of the experiments the spraying was performed with the so-called "Little Climax" force pump, fitted with the Nixon nozzle. The Vermorel nozzle was tested for applying the Bordeaux mixture, but was little used, as the Nixon nozzle was satisfactory. The liquids were always applied in sufficient quantity to pretty thoroughly wet the foliage.

EXPERIMENT IN THE TREATMENT OF APPLE SCAB.

The fungicides tested the past season for preventing apple scab were:

I. Copper carbonate dissolved in ammonia, as used in 1889, and also suspended in water.

II. The sulphur powder, so called, tested in 1889, and introduced by Mr. E. Bean, of Jacksonville, Florida.

III. The compound of ammoniated copper sulphate and ammonium carbonate furnished by your department as Mixture No. 5.

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* No systematic meteorological records were kept at Ithaca during the early part of the season, but the following notes were made by Mr. Hatch: "Heavy rain May 9, 10, and 12; May 31, rains since the 13th, severe and frequent; rain June 3, 4, and 5; June 15, rained heavily almost every day or night since the 7th; June 18, hard rain; June 29, heavy rain June 20, 21, 22, 23, and 24, thunder on the 24th, very hot since the 23rd, 90° to 95° several days, with very humid atmosphere, more rain on the 29th; July 11, very heavy rain; July 13, rain with wind and thunder; August 19, weather very dry since middle of July." After August 1, a careful meteorological record was kept by a daughter of Mr. Hatch, in accordance with the rules of the Signal Service, from which it appears that 3.46 inches of rain fell on 12 days during August and 2.5 inches on 6 days during September.

At Madison 7.02 inches of rain fell on 13 days in June and 1.81 inches in 7 days in July.

Plan of the work.—The questions to which answer was sought in the use of these materials, and the methods employed to answer them were:

I. The comparative efficacy of the three compounds named in preventing apple scab.

Two trees of the Fameuse variety were sprayed with each of the three compounds, and their crops compared with those of check trees not sprayed at all.

II. The efficacy of copper carbonate applied suspended in water, as compared with that dissolved in ammonia.

It was found in 1889 that the ammonia, unless very largely diluted, endangers the foliage, and gives the fruit a russety appearance. It also dissolves the arsenic of Paris green or London purple when used for the codling moth at the same spraying, and this indirectly causes injury to the foliage. To answer the second question, two Fameuse trees were sprayed with copper carbonate dissolved in ammonia and two others with the same material simply stirred in water, as we apply Paris green. The crops of these two pairs of trees were compared with each other, and also with those of the check trees.

III. The value of treatment previous to the opening of the flowers.

Two Fameuse trees were sprayed once with ammoniacal copper carbonate before bloom and three times after, and their crops compared with those of two other trees sprayed four times after bloom. The crops of the four trees were compared with those of check trees not sprayed. Also, two trees of the Canada peach variety were sprayed with suspended copper carbonate twice before bloom and twice after, and their crops compared with those of two others sprayed with the same four times after bloom, and also with those of check trees.

IV. The number of treatments necessary to secure the most beneficial results.

Two Fameuse trees were sprayed with ammoniacal copper carbonate 2, 4, 6, and 8 times respectively, and the crops of the different pairs compared with each other and with check trees not sprayed at all.

The strength at which the fungicides were used.—The copper carbonate was in every case of the precipitated form and when applied in the diluted ammoniacal solution was used at the rate of an ounce of the salt to 25 gallons of water. One ounce was dissolved in a quart of ammonia (strength 22° Baumé) and the solution added to the water just before the treatment at the rate named.

When the copper carbonate was applied in suspension an ounce was first well stirred in a small quantity of water and the mixture thus formed was added to 12½ gallons of water.

The sulphur powder was used according to the directions on the package, *i. e.*, 10 pounds were added to a barrel of water and allowed to stand a few hours before use. The yellow colored liquid resulting was employed without dilution. As the barrel became nearly empty it was again filled with water and the solution used as before.

The mixture No. 5 was used as suggested by you, viz, 12 ounces to 22 gallons of water in the first two treatments, but owing to injury to the foliage it was diluted one-third in the later sprayings.

The trees selected for the experiment were of medium size, and all promised a full crop of fruit, though as appears from the table on a succeeding page, all did not mature a full crop. None of the trees used in the experiment of 1889 were employed in the experiment here reported. The first treatment was given on May 5, and others were made May 13, 31, June 5, 16, 28, July 14, 25, August 6, 19, and September 2. Of course all the trees were not treated at all the sprayings. The treatment of June 5 was intended to supplement that of May 31, much rain having fallen between these dates. As the apples showed indications of maturity the entire crop on each of the trees selected for the experiment was gathered and assorted into three qualities as follows:

(1) Fruits quite free from scab.

(2) Fruits showing scab spots but not of sufficient size or number to distort the apples.

(3) Fruits more affected.

In assorting the crops only the scab was considered; size and insect injury being ignored. Some of the fruits placed in the first quality were badly distorted by insect injuries, and were very small in size. In like manner some fruits of comparatively large size were of necessity placed in the third quality.

The numerical data relating to the experiment are chiefly grouped together in the accompanying table but as this table is necessarily somewhat complicated the more important points brought out are graphically illustrated on succeeding pages.

Tree No.	Variety.	Sprayed with—	Number of times sprayed.*	Dates when sprayed.
1	Canada peach	Suspended copper carbonate.	2 before bloom; 2 after bloom.	May 5, 13, and 31, June 5.
2	....do	....do	....do	Do.
3	....do	....do	4	May 31, June 5,† 16, and 28, July 14.
4	....do	....do	4	Do.
5	....do	Check—not sprayed		
6	....do	....do		
7	Fameuse	Suspended copper carbonate.	6	May 31, June 5,† 16, and 28, July 14 and 25, Aug. 16.
8	....do	....do	6	Do.
9	....do	Ammoniacal copper carbonate.	6	Do.
10	....do	....do	6	Do.
11	....do	....do	2	May 31, June 5† and 28.
12	....do	....do	2	Do.
13	....do	....do	4	May 31, June 5,† 16, and 28, July 14
14	....do	....do	4	Do.
15	....do	....do	8	May 31, June 5,† 16, and 28, July 14 and 25, Aug. 6 and 19, Sept. 2.
16	....do	....do	8	Do.
17	....do	....do	1 before bloom; 3 after bloom.	May 7 and 31, June 5,† 16, and 28.
18	....do	....do	....do	Do.
19	....do	Bean's Sulphur Powder.	6	May 31, June 5,† 16, and 28, July 14 and 25, Aug. 6.
20	....do	....do	6	Do.
21	....do	Mixture No. 5	8	May 31, June 5,† 16, and 28, July 14 and 25, Aug. 6 and 19, Sept. 2.
22	....do	....do	8	Do.
23	....do	Check—not sprayed		
24	....do			

* Always sprayed *after the petals had fallen* unless otherwise stated.
† The spraying of June 5 was intended to supplement that of May 31.

Tree No.	Variety.	Number of fruits.	Per cent of fruits in—			Average for the two trees; per cent of fruits in—			Weights of 100 fruits.		
			First quality.	Second quality.	Third quality.	First quality.	Second quality.	Third quality.	First quality.	Second quality.	Third quality.
									Ozs.	Ozs.	Ozs.
1	Canada peach	257	16.34	77.43	6.23						
2	....do	211	6.64	76.30	17.06	11.49	76.86	11.14			
3	....do	175	5.71	72.57	21.72						
4	....do	138	7.25	45.65	47.10	6.48	59.11	34.41			
5	....do	238	2.94	61.35	35.71						
6	....do	865	0.36	68.98	30.66	1.65	65.16	33.18			
7	Fameuse	633	3.79	41.71	54.38				313	275	259
8	....do	632	1.58	40.98	57.44	2.68	41.34	55.91	300	286	199
9	....do	1,027	2.82	32.91	64.27				300	281	202
10	....do	850	8.82	35.30	55.88	5.82	34.10	60.07	262	242	181
11	....do	906	1.55	25.94	72.51				279	259	186
12	....do	1,161	3.16	37.15	59.69	2.35	31.54	66.10	154	243	172
13	....do	1,042	5.57	42.23	52.20				288	257	178
14	....do	968	5.58	43.80	50.62	5.57	43.01	51.41	280	254	182
15	....do	1,746	4.07	44.67	51.26				280	258	176
16	....do	581	7.84	45.32	46.84	5.95	44.99	49.05	288	267	198
17	....do	912	20.61	56.47	22.92				241	272	217
18	....do	1,332	25.60	47.22	27.18	23.10	51.84	25.05	283	255	198
19	....do	13,59	1.18	23.18	75.64				256	254	182
20	....do	707	1.82	29.00	69.18	1.50	26.09	72.41	300	290	203
21	....do	1,096	18.70	52.56	28.74				221	217	166
22	....do	719	9.04	50.77	40.19	13.87	51.66	34.46	245	231	186
23	....do	258	1.16	22.87	75.97				300	265	182
24	....do	762	3.59	42.82	53.59	2.37	32.84	64.78	307	259	189

The comparative efficacy of copper carbonate, sulphur powder, and Mixture No. 5 *in preventing Apple Scab.*—This will appear by consulting Fig. 1 and Pl. IV, Fig. 5. In the experiment the trees were sprayed six times with the sulphur powder and eight times with the Mixture No. 5. We therefore compare those treated with the former with the trees sprayed six times with the ammoniacal copper carbonate, and those treated with the latter with those sprayed eight times with the ammoniacal copper carbonate. In Fig. 4, Pl. IV, is shown the proportion of fruits in each of the three qualities from the trees sprayed eight times with the Mixture No. 5, and the copper carbonate as compared with those from the untreated trees.

The white portion represents the first quality, the diagonal lines the second, and the black portion the third quality.

From this it appears that the Mixture No. 5 was considerably the more efficacious. In Fig. 5 we compare the effect of six treatments with the sulphur powder and ammoniacal copper carbonate with that of the check trees, from which it would seem that the sulphur powder actually appeared to increase the amount of scab. It is more probable, however, that the trees treated with this material were from some cause more than usually affected with the disease which the sulphur compound, possibly owing to its ready solubility which caused it to be easily washed off by the rains, entirely failed to prevent.

The efficacy of copper carbonate suspended in water as compared with that dissolved in ammonia.—From Fig. 6 it is evident that the results from six sprayings of copper carbonate applied in suspension and in ammoniacal solution were very meager in both cases. The first and third qualities were larger in the case of the solution, while the second was larger in that of the suspended copper carbonate. If the results may be assumed to teach anything it would seem that there was little difference in the efficacy of the two methods of application.

From Fig. 8, in which the data represent the results of spraying the Canada peach apple with suspended copper carbonate before and after bloom, the benefit from the treatment before bloom is very perceptible, which indicates that this method of using copper carbonate is capable of giving good results.

The value of treatment previous to the opening of the flowers.—From Fig. 7 it is evident that one treatment of the Fameuse apple before the flower had opened with three treatments after the petals had fallen was much more efficacious in preventing the scab than four treatments made after the falling of the petals, a result which is corroborated in Fig. 8, which represents the results secured in treating two trees of the Canada Peach twice before bloom and twice after, as compared with four treatments after bloom.

The number of treatments necessary to secure the most beneficial results.—From Fig. 9 it appears that eight treatments gave only slightly better results than four, but that four gave considerably better than two. The first two treatments succeeding the falling of the petals (made May 31 and June 16), it would appear, gave absolutely no results, while the two made June 28 and July 14 seem to have proved beneficial. The excessive rains during the early part of June doubtless washed off the fungicides from the foliage before they had time to act, and at the same time promoted the growth of the fungus. The lesson suggested is that treatments made after midsummer are of doubtful value.

To what extent does the scab reduce the size of the fruit?—As will appear from the table on a preceding page all of the fruits of the Fameuse apple in the different qualities were weighed. These weights furnish data from which we may compute with a fair degree of accuracy the influence of the scab in reducing the size of the apples. As only the scab was considered in assorting, we are perhaps justified in assuming that the reduced size of the scabby fruits was due to the exhaustive action of the fungus, and that had all the apples been free from the disease all would have been as large as those of the first quality. From the data it appears that, averaging the crop from all of the Fameuse trees, the fruits of the first quality weighed 262 ounces per hun-

dred, those of the second 258, and those of the third 189. The average weight of the fruits in the different qualities appears below in Fig. 2.

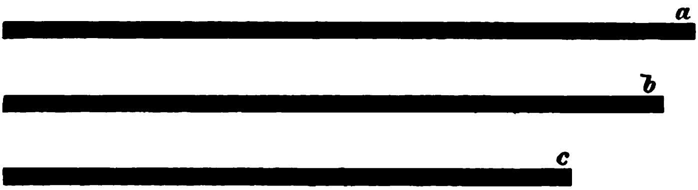

FIG. 2.—*a*, first quality; *b*, second quality; *c*, third quality.

Had all the fruits from the eighteen Fameuse trees been equal in size to those of the first quality the actual increase of the crop would have been a trifle over 413 pounds, or more than 17.8 per cent of the entire yield of apples. This, it should be remembered, only represents the effect of the scab in reducing the size of the fruits actually developed. It does not take into account the injury to the appearance of these fruits, the fruits that were prevented from developing, nor the injury wrought by the fungus to the vigor of the tree.

Cost of the treatments.—From the materials and the time consumed in the treatments, counting copper carbonate at 50 cents per pound, ammonia $1.50 per gallon, and labor 15 cents per hour, I have computed the cost of the treatments with these materials approximately as follows:

Cost for spraying one tree once with ammoniacal copper carbonate:

For materials	$.022
For labor	.0375
Total	.0595

Or, including labor of preparing, about 6 cents.

Suspended copper carbonate, using double the amount as in the above:

For materials	$.0039
For labor	.0375
Total	.0414

Or, including labor of preparing, about 4.2 cents.

These prices could be considerably reduced by purchasing the materials in quantity and making the applications with a larger force pump.

I have not been informed as to the cost of the sulphur powder or Mixture No. 5.*

Recapitulation.—The results of the experiment in the treatment of apple scab, described in the foregoing pages, suggest the following conclusions:

I. That in seasons of excessive rains in early summer the scab on badly infested trees can not be wholly prevented by the treatments given in this experiment.

II. That of the substances tested the mixture of ammonium carbonate and ammoniated copper sulphate (designated as Mixture No. 5)† was most efficient.

III. That the precipitated copper carbonate applied stirred in water, as we use Paris green, is nearly or quite as efficient as when one-half the amount was applied dissolved in ammonia, a point which, if confirmed by further trials, is important, as it will render possible the use of Paris green for the codling moth at the same spraying with the fungicide.

IV. That early treatments, and especially at least one treatment previous to the opening of the flowers, is extremely important.

* I mention, on the authority of Dr. S. M. Babcock, that this material is, when dissolved in water, very similar in chemical composition to the ammoniacal copper carbonate. On adding water to the mixture a chemical change takes place, the result of which is the formation of copper carbonate dissolved in ammonia and ammonium sulphate.

† Mixture No. 5 costs practically the same as the ammoniacal solution.

V. That sprayings after midsummer are at best of doubtful value.

VI. That on trees badly infested with scab the fruits that develop may be so far reduced in size by the fungus as to diminish the crop nearly 20 per cent; but this is doubtless but a small part of the injury actually produced.

In conclusion, I would recommend that in future experiments a larger number of trees be employed as duplicates. A study of the results secured in this experiment, as well as those gained in the trial of 1889, makes it clear that two trees are not always sufficient to furnish data for drawing definite conclusions.

EXPERIMENTS IN THE TREATMENT OF THE SEPTORIA OF THE RASPBERRY AND BLACKBERRY.

The fungicides tested for the Septoria of the raspberry and blackberry were:

I. Bordeaux mixture.

II. Ammoniacal copper carbonate.

III. The mixture of ammoniated copper sulphate and ammonium carbonate, used for the apple scab as Mixture No. 5.

The Bordeaux mixture was made by slacking 6 pounds of lime in one vessel, and dissolving 4 pounds of copper sulphate in another, uniting the contents of the two vessels on the cooling of the lime and diluting the whole with water to 22 gallons.

After the first two treatments, the Bordeaux mixture was diluted one-third, as the foliage showed indications of injury.

The other two fungicides were used in the first two treatments of the strength noted in the experiment for apple scab, viz, an ounce of copper carbonate dissolved in a quart of ammonia, and the solution diluted with 25 gallons of water; 12 ounces of the mixture No. 5 dissolved in 22 gallons of water. After the second spraying, the solution of mixture No. 5 was diluted one-third for the reason named above.

The varieties of raspberry selected for the experiment were Cuthbert for red, and Tyler and Gregg for black; those of the blackberry were Stone's hardy and Ancient Briton. All were growing in somewhat dense rows, and at the time of the first spraying, May 31, presented a thrifty appearance, and gave promise of a good crop of berries. At this time the leaves were nearly full grown and the flower buds though visible had not yet opened. Forty feet of row of each variety selected for the experiment was treated at the different sprayings with each of the fungicides named. Treatments were given on May 31, June 5, 18, 28, July 7 and 14. In the treatment of July 28, the Tyler and Cuthbert raspberries were omitted, as there were unmistakable indications of injury to the foliage. In the treatment of July 7 and 14 all of the raspberries were omitted, as the fruit was beginning to ripen.

During my visit to Mr. Hatch's place, on July 24, it was evident that all of the fungicides used had injured the foliage to some extent on both the raspberry and blackberry. The injury seemed most pronounced in the case of Mixture No. 5, and least in that of ammoniacal copper carbonate. The foliage of the black cap raspberries showed more injury than that of the red, and there were indications that the crop would be injured or at least retarded. It was also evident that the Bordeaux mixture, on account of its adherence to the fruit, is very poorly adapted for use upon these crops. The Septoria was visible at this time on untreated rows of both the raspberry and blackberry. Where the treatments had been given, the blackness of the foliage rendered it difficult to decide to what extent the Septoria was active.

The crop on all of the treated plants, except those of the Tyler raspberry,* and of the plants set off as checks was measured by Mr. Hatch at each picking.

As the best means of determining the results of the treatments upon the yield of berries, the bearing wood from each section of row devoted to the experiment, including the checks, was cut out after the harvest, bound into bundles and weighed. The computations rendered possible from the data thus secured appear in the following table:

* The fruit and foliage of the Tyler raspberry were practically destroyed by the fungicides.

Table showing the results of treatment of raspberry and blackberry for Septoria.

	Sprayed with—	Yield of berries.	Weight of bearing wood.	Calculated yield on 100 pounds of bearing wood.
		Quarts.	*Pounds.*	*Pounds.*
Raspberry:				
Cuthbert (sprayed 3 times)........	Bordeaux mixture..........	8¾	10.5	83.33
	Copper carbonate...........	14	15.5	90.32
	Mixture No. 5..............	16¼	22	73.86
	Check	21¼	14.5	146.55
Gregg (sprayed 4 times)...........	Bordeaux mixture..........	2.4	12.5	19.2
	Copper carbonate...........	4⅔	16	29.12
	Mixture No. 5	3¾	13	28.84
	Check not sprayed..........	16¼	15.3	106.21
Blackberry:				
Stone's Hardy (sprayed 6 times)...	Bordeaux mixture..........	17	19.5	87.02
	Copper carbonate...........	19¼	18	106.94
	Mixture No. 5	14¼	14	101.79
	Check	13¾	16.5	83.33
Ancient Briton (sprayed 6 times)..	Bordeaux mixture..........	10¾	8.25	130.3
	Copper carbonate...........	17¾	8	221.87
	Mixture No. 5	16¼	8.125	200
	Check not sprayed..........	18¼	9.5	205.48

From the table it would appear that the yield of raspberries was seriously injured by all of the treatments, and especially by the Bordeaux mixture and Mixture No. 5, but that the crop of blackberries was somewhat improved by the use of the copper carbonate. In the Stone's Hardy, the yield seems to have suffered from none of the treatments, and to have been improved by both the copper carbonate and Mixture No. 5, while in the Ancient Briton the crop seems to have been injured by the Bordeaux mixture.

The cost of making the individual treatments in the experiment upon the raspberry and blackberry would not differ much from that of spraying one apple tree with each of the fungicides. An estimate of the cost in the case of the copper carbonate may therefore be made by referring to the paragraph giving the cost of the apple sprayings. The cost of the Bordeaux mixture would be slightly greater than that of the ammoniacal copper carbonate.

From this experiment it is evident—(1) That the foliage of the raspberry is delicate, and can not endure applications of a corrosive nature; (2) that the foliage of the blackberry though more resistant than that of the raspberry is more susceptible to injury than that of the apple; (3) that none of the treatments given are to be recommended for the raspberry, and that of the materials used only the copper carbonate solution can be pronounced beneficial in the case of the blackberry.

EXPERIMENT IN TREATING THE POTATO ROT.

The only fungicide tested in this experiment was the Bordeaux mixture prepared as noted in the preceding article. The plat selected for the experiment included about half an acre of ground nearly in the form of a square, and was planted with snowflake potatoes May 31, the seed being placed in hills 3½ feet apart each way.

Five rows extending through the center of the plat in each direction were staked off as a check area, the four corner plats thus separated being subjected to the treatment. The SW. plat was treated with the Bordeaux mixture at its full strength; for the NE. plat the mixture was diluted about one-fourth; for the SE. plat about one-third, and for the NW. plat about one-half.

The first treatment was given July 3d, at which time the plants were 3 to 15 inches high, and apparently entirely healthy. Other treatments were given July 14 and 25, August 6 and 19, and September 2.

More or less of the mixture was visible upon the vines at all times after the first spraying until the crop was harvested. At the time of the fifth spraying (August 19) it was evident that the treatment was bearing fruit, as the foliage of the check rows

was turning yellow and in spots becoming brown and apparently dying, while that of the treated portions was still fresh and green. At the last spraying (September 2) the effect of the treatment was still more marked, the vines in the check rows being mostly dead or severely blighted, while very little of the blight was visible on the treated plats.

During my visit to Mr. Hatch's place in the latter part of September, the check rows were conspicuous by their brown and dry appearance at a distance of several rods from the field, while the vines in the treated areas were still for the most part green and growing. A frost occurred September 28, which destroyed most of the surviving foliage. October 9 to 15 the potatoes in the various plats were dug, assorted, counted, measured, and weighed. The numerical data appear in the following table. The results of the treatment appear more clearly from the graphic diagram (Fig. 3), in which the white portion represents the yield of merchantable potatoes, and the diagonal lines that of the small potatoes.

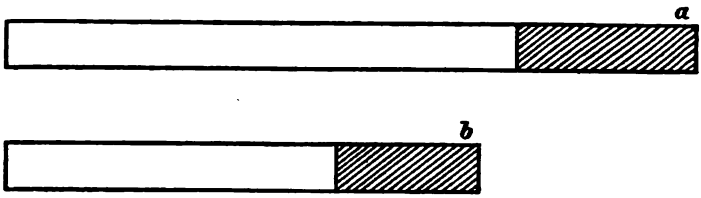

FIG. 3.—*a*, after six treatments; *b*, not treated.

Plat.	No. of hills.	Merchantable yield.		Total yield.		Yields calculated to a uniform number of hills.			
						Merchantable.		Total.	
		No.	Weight.	No.	Weight.	No.	Weight.	No.	Weight.
			Pounds.		*Pounds.*		*Pounds.*		*Pounds.*
Northeast corner	321	2,255	835	6,815	1,133	2,669	988	8,068	1,310
Northwest corner	287	2,530	871	6,455	1,103	3,350	1,049	8,547	1,459
Southeast corner	340	2,176	903	7,462	1,320	2,432	1,009	8,340	1,475
Southwest corner	343	3,075	1,127	6,905	1,367	3,407	1,249	7,650	1,514
Check	380	2,125	698	6,200	1,000	2,125	698	6,200	1,000

The unequal number of hills in the different plats arose from two causes, viz, the whole area was not quite regular in outline, and as the ground was a little sloping, the heavy June rains washed out some hills in places. The numbers recorded in the table represent the hills that matured their crop, as determined by counting before the potatoes were dug.

As the check rows traversed the whole planted area in both directions, we are justified in assuming that they represented an average of the whole plat so far as the conditions of soil and culture were concerned, and that any difference in the yield of these rows, and that of the average of the four treated plats, when calculated to a given number of hills was due to the treatment. In other words, had each of the four treated plats contained the same number of hills as the check rows, the aggregate yield from them would have been, without treatment, approximately four times as much as that from the check rows. Considering the yield of merchantable potatoes, then, the four treated plats would have yielded without the treatment 4 × 698, or 2,792 pounds, whereas they actually yielded 4,295 pounds, or an increase, presumably due to the treatment, of 1,503 pounds, a fraction over 25 bushels. From the figures, it would appear that the applications to the southwest plat, in which the fungicide was used at its full strength, were most effectual, and that for the potato, the Bordeaux mixture should not be diluted.

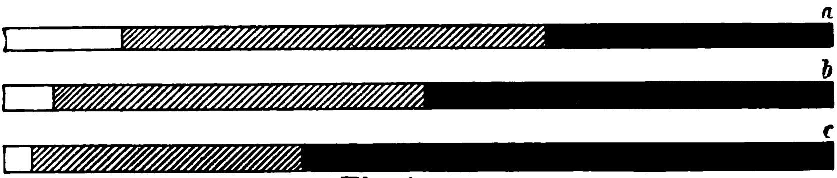

Fig. 4.

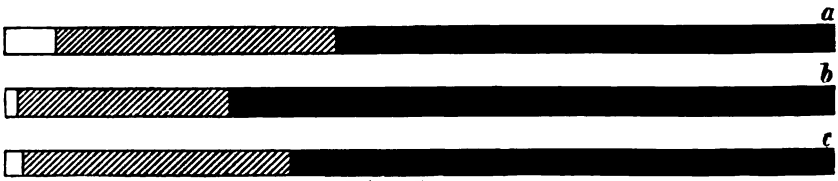

Fig. 5.

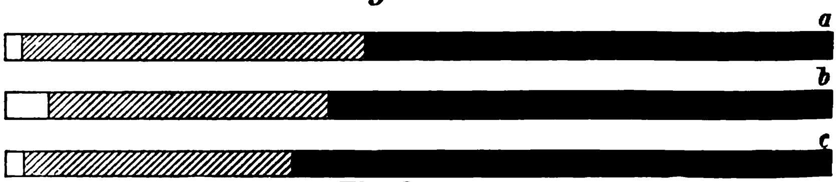

Fig. 6.

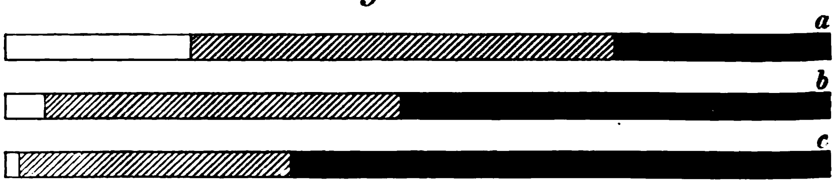

Fig. 7.

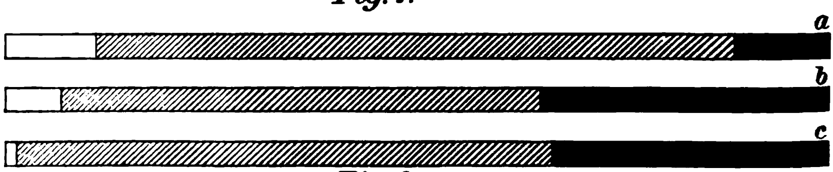

Fig. 8.

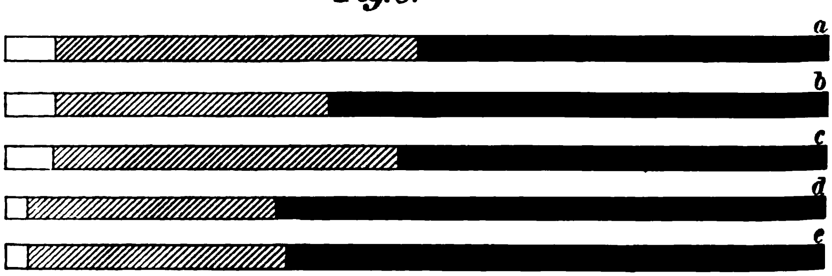

Fig. 9.

GALLOWAY, ON EXPERIMENTS IN TREATMENT OF PLANT DISEASES.

The cost of the treatment was approximately as follows:

69 pounds copper sulphate, at 9 cents	$6.21
24 hours' labor, at 15 cents	3.60
Lime and labor of preparation	.50
Total	10.31

from which it appears that the treatment, though made with a small hand force pump, and in the most thorough manner, was more than compensated for by the increased yield secured.

It should be added that none of the potatoes were decayed at the time of digging, and that there were no indications that the blight which so injuriously affected the foliage of potatoes the past season on the check rows of our experimental plat, and throughout southern Wisconsin, was connected in any way with the potato-rot fungus, *Phytophthora infestans*. But whatever the affecting disease was, it is evident that the treatment proved a remedy for it.

Mr. Hatch states that the Colorado potato beetle *Doryphora decemlineata* did not attack the potato plants in the treated plats, an additional point of some value in favor of the treatment.

DESCRIPTION OF PLATE.

Plate IV.

Fig. 4. The value of mixture No. 5, as compared with that of ammoniacal copper carbonate.
- *a*, mixture No. 5, sprayed eight times.
- *b*, ammoniacal copper carbonate, sprayed eight times.
- *c*, check, not sprayed.

Fig. 5. The value of ammoniacal copper carbonate as compared with Bean's sulphur powder.
- *a*, ammoniacal copper carbonate, sprayed six times.
- *b*, Bean's sulphur powder, sprayed six times.
- *c*, check, not sprayed.

Fig. 6. The value of copper carbonate suspended in water as compared with that dissolved in ammonia.
- *a*, suspended copper carbonate, sprayed six times.
- *b*, ammoniacal copper carbonate, sprayed six times.
- *c*, check, not sprayed.

Fig. 7. The effect of spraying before bloom—Fameuse.
- *a*, sprayed once before bloom, three times after.
- *b*, sprayed four times after petals had fallen.
- *c*, check, not sprayed.

Fig. 8. The effect of spraying before bloom—Canada Peach.
- *a*, sprayed twice before bloom, and twice after.
- *b*, sprayed four times after bloom.
- *c*, check, not sprayed.

Fig. 9. *a*, eight treatments with ammoniacal copper carbonate.
- *b*, six treatments with ammoniacal copper carbonate.
- *c*, four treatments with ammoniacal copper carbonate.
- *d*, two treatments with ammoniacal copper carbonate.
- *e*, no treatment.

ADDITIONAL NOTES BY MR. HATCH.

EXPERIMENTS IN TREATING APPLE SCAB.

(Fusicladium dendriticum.)

It is my opinion that the first spraying for the apple scab should be made much earlier than the time usually selected for the first spraying for the codling moth. The foliage is then pretty well formed, and the past season we found well developed scab spots upon the leaves at that time. The few scab spots found later in the season that appeared to have been killed by the treatment warrants the conclusion that the chief benefit of spraying comes through the destruction of the spores that have gained lodgment upon the fruit and foliage. The results in the case of the trees treated before blooming also points in this direction. I think it possible that a treatment before the buds have commenced to expand would be productive of much good.

The extremely heavy rains of June and the first part of July rendered the season very unfavorable for the work and resulted in loss of the benefits of spraying my main orchards for both apple scab and insects. Still, by persistent effort I think we have some valuable results. At least we have done all possible to make them successful, and our thanks are due to Professor Goff for his aid at various stages of the work. My loss from apple scab has been very serious, not only in fruit but also in foliage, and the magnitude of its injury warrants still greater efforts in combatting it.

We found Mixture No. 5 very persistent upon the foliage, but apparently too strong in ammonia. Its caustic effects were so apparent that for some of the later sprayings we reduced the quantity one-third. The solution of carbonate of copper, although diluted 100 parts with water, had similar effects, and I would suggest that it may possibly be found equally efficient if diluted even 200 times. We used strong ammonia (supposed to be 22° Baumé) to make a saturated solution (about 1 ounce to 1 quart). In using carbonate of copper in water alone I think we used too little. There would have been no harm to the foliage if used several times as strong, nor indeed is it likely to prove injurious in any degree.

The treatment in the case of the blackberry and raspberry was for *Septoria rubi*, a small fungus causing the foliage to turn yellow, wither, and fall before the fruit matures. Here again earlier treatment seems to be advisable. The first spraying was when leaves were about full grown. At this time Septoria showed plainly on the leaves, and it is our opinion that preventive treatment is more desirable than curative. The first Bordeaux mixture used was made with 6 pounds of copper sulphate and 4 pounds of lime. This injured the foliage so much that we reduced it with water one-third, and afterwards used 6 pounds of lime in place of 4. The other fungicides also proved injurious to the leaves, and we concluded that the black raspberries especially are very tender in foliage. The Bordeaux mixture proved especially bad, not only in injury to the foliage, but also in adhering to the fruit so as to make it unfit for use. It should be mentioned that the raspberries treated were each side of a row of blackberries that were last year destroyed by the orange rust. Still no rust was visible this year on either the raspberry or blackberry bushes that sprouted where the row was removed. The loss by Septoria this season has been quite large.

THE POTATO EXPERIMENT.

Rot has not been prevalent here for a few years. In order to secure its development for treatment we ordered a barrel of seed from Ohio, where rot was plenty last year, but failed to secure any affected potatoes. We then planted with such seed as we had, mostly Snowflakes, with a few mixed kinds. To still further assure rot we planted late, May 31, and supplemented 4 rows along one side of the plat which we covered with a fork full of sheep manure in each hill. The heavy rains not only washed out some of the potatoes, but so compacted the soil as to make them very slow in coming up and getting a start. The last of July and the month of August were extremely dry and no rot appeared. Even the manured rows were sound and

good, no Phytophthora being visible anywhere. There was, however, a blight of the foliage that has proved very general and widespread throughout all this region. The leaves turned yellow in spots, then brown, and the entire vines died long before the growing season was completed. The check rows in the experimental plat and my own potatoes elsewhere on my farm were all seriously affected with this blight. By the first of September this was so emphatic that the check rows were easily selected from the plat, the treated vines showing mostly bright and green when frost came. Still there was an occasional hill among the treated vines showing the same trouble as the untreated, but not in so large a degree.

We had expected to use our field pump in a large barrel mounted on farm trucks with the Vermorel nozzle attached to the hose, but found that we could not go over the plat and make the turns with the team without running into the potatoes and injuring them. So we abandoned its use and did the entire work by hand with our Nixon Climax pump, using a No. 3 Nixon nozzle. We overcame the difficulty of clogging by having a piece of brass wire strainer cloth soldered over the lower end of the suction pipe. This had a mesh finer than the orifice of the nozzle and was a complete remedy for clogging, not only in using the Bordeaux mixture, but also in all other spraying done by us.

Another variation we made was in using the Bordeaux mixture. We hauled out for each treatment a barrel containing 12 pounds each of copper sulphate and lime and 44 gallons of water properly mixed to make the regular Bordeaux mixture. We also took another barrel of clear water. At the beginning we stirred the mixture, allowed it to settle a minute, and took out two or three pailfuls to use. After using enough for the southwest corner, clear water was added to the large barrel, and so on until the plat was gone over, 70 to 75 gallons in all being used. This would give about the following strength nominally to each plat: Southwest, full strength; southeast, two-thirds; northeast, three-fourths; northwest, one-half. There was, however, about the same appearance in the consistency of the liquid used for each plat on account of the sediment in each lot being about all the water would carry, and the appearance of the vines after spraying was the same in each plat. From the time of the first spraying the application was always more or less visible. I thought there was a difference in the vigor of the vines in favor of the northeast corner, but suppose the figures as tabulated by Professor Goff will show this matter clearly. At any rate I venture the opinion that it may be well to experiment with Bordeaux mixture in a more diluted form than the regular formula.

Another apparent result of the spraying was in regard to the Colorado potato beetle. I found it necessary to go over the check rows with London purple the second time, but the treated part was almost entirely free from them. It would thus appear that where the mixture is used for rot and blight it may also be efficient as an insecticide.

DISEASES OF THE ORANGE IN FLORIDA.*

By Lucien M. Underwood.

The following notes on the diseases of the orange in Florida were made during a visit to that State during the months of February, March, and April of the present year (1891). They consist simply of the results of observations in the field and evidence collected from intelligent growers in various portions of the State. The orange groves and methods of cultivation and treatment were observed in the following counties: Brevard, Citrus, Hernando, Lake, Manatee, Marion, Orange,

* Professor Underwood collected the information embodied in this report while acting as special agent for the Division of Vegetable Pathology.—[B. T. G.]

Pasco, Polk, St. John's, Volusia. Nine other counties were traversed and visited during the winter.

GENERAL CONSIDERATIONS.

(1) The cultivation of the orange in America is of comparatively recent origin. The very oldest groves in Florida do not reach a half century, and there are few groves of even half that age. As the orange trees do not usually show disease until they reach full bearing it is natural to suppose that the absence of diseases in certain localities is due to the fact that the groves are too young to show the effects of disease; it is also natural to expect that as the groves grow older certain diseases will become more and more prevalent. Certain it is that the greatest ravages of disease are to be seen among the oldest groves.

The fact that the orange industry is comparatively a new one is the cause of much injury to many orange groves because of lack of experience in cultivation and fertilization.

The method and time of cultivation are an important matter for orange-growers. Judging from observation in many places there is more of a tendency in the direction of overcultivation than the reverse. Moreover, the method, time, and extent of application of fertilizers are exceedingly important, as well as the adaptation of the kind of fertilizers used to the varying conditions and necessities of the soil. Much injury results to groves by (*a*) overcultivation and (*b*) unfortunate treatment with fertilizers in quantity, quality, and method of application.

Unfortunately for the orange-growers the State experiment station is located too far north to be within the belt of profitable orange-growing. There is pressing need of more organized experimental work in this direction in order to attain the best method of treatment and thus avoid many of the causes of injury from the sources above mentioned.

(2) There exists in Florida a great diversity of soil and a large proportion of the State is not adapted to orange-culture. In fact, only a few favored localities are likely to long maintain their reputation for the cultivation of citrus fruits. Many groves now planted will never reach maturity, or, if so, will require more artificial fertilizing to mature a crop than will be profitable to the owner. One source of disease is the starved condition of certain groves, owing to natural deficiencies of soil, for weakened vitality increases the liability to become the prey of organic troubles.

(3) Many orange groves were started in regions where the trees are subjected to low temperature during the winter months. Even where frosts do not kill the young twigs outright the vitality of the tree is much weakened by the effect of either a cold snap or continued cold weather, and consequently more likely to be preyed upon by organic diseases. The great frost of 1886 and the unexpected late frosts of 1890 and 1891 (occurring in March in the former and in April in the latter year) have left their marks on the orange groves in many quarters, not

merely in external and visible manifestations, but even more in the impaired vitality of the orange trees. It may be added that some of the effects of frosts are not infrequently confounded with diseases of a very different nature.

(4) The exceedingly dry season of the past year has also left its traces in the impaired vitality of many trees, and the uncertainty of rain and the liability of drought are inducing many to introduce irrigation plants, which in the hands of careless cultivators are likely to become a source of harm as well as good.

CLASSIFICATION OF DISEASES.

The diseases affecting the orange may be arranged under four groups:

(1) Those resulting from climatic conditions and environment, as frost, drought, natural defects of soil, natural excesses of soil constituents, and undue moisture.

(2) Those produced by insect pests. Although this group is outside the limits of this paper, we may mention in passing that during the present season the long scale,* the red spider,† and the rust mite‡ are apparently the most troublesome pests of this nature, but the first is likely to be kept in check by the lady bugs (*Coccinellidæ*), the second will succumb to spraying, and the third may be held in check by the character of the cultivation.

(3) Those due to injurious cultivation and fertilization.

(4) Those due to the agency of parasitic fungi and bacteria.

Only the diseases of the last two groups will receive notice here. The diseases noticed during the early season of 1891 were as follows:

I. Die-back.
II. Foot-rot. } Probably caused by improper cultivation or fertilization.
III. Blight. Possibly caused by bacteria.
IV. Scab.
V. Leaf spot. } Caused by parasitic fungi.
VI. Sooty mold. Caused by a saprophytic fungus.
VII. Leaf glaze. Caused by a leaf lichen.

I.—DIE-BACK.

(1) *Nature of the disease.*—This disease first makes its appearance in strong shoots of the season in the form of pustules or blisters on the stems near the point of attachment of the leaves. These when opened appear to contain a reddish, gummy substance. In later stages of the disease these pustules rupture and extend in cracks along the twig, the reddish gummy substance coming to the surface and spreading until the whole twig becomes diseased and finally dies back to the main stem. This peculiar and characteristic effect gives rise to the appropriate, if not elegant, popular name of the disease. In badly infected trees most or all of the fruit falls when young; that which matures is likely to be mis-shapen and discolored. There seems to be no evidence that the disease is contagious.

Trees that have been affected with die-back and have recovered from its effects will reveal it years afterward in the sudden bends of the

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* *Mytilaspis gloverii*, Pack. † *Tetranychus telarius*, L. ‡ *Typhlodromus oleivorus*, Ashm.

smaller branches. The main twigs die and the smaller side branches, having taken up the growth and received the nourishment intended for the main branch, become larger and appear as if the branches had taken sudden turns in the process of their growth.

(2) *Distribution.*—The disease does not seem to have occasioned much alarm, although it appears to be widespread and liable to occur whenever the causes that produce it are present. Bad cases of it occur in various portions of the orange belt visited.

(3) *Causes.*—It is the almost universal testimony of growers that excess of nitrogenous fertilizers will either produce the die-back, or, what is equivalent, will produce the conditions under which the disease will develop. The evidence collected in the field bearing on this point justifies a similar conclusion.

Among others the following conditions, under which the disease is prevalent, point to this source of the difficulty:

(*a*) Proximity of orange trees to horse stables or piles of horse manure.

(*b*) Proximity of trees to houses where, with the carelessness induced by the porous sandy soil, household slops are thrown indiscriminately.

(*c*) Proximity of trees to chicken pens. The habitual roosting of poultry in orange trees is likewise liable to induce the disease. In several groves visited it had been the former custom to use portable chicken pens which were moved from tree to tree in order to secure a natural guano in the place where it was supposed to be most beneficial. In all these cases the practice had been stopped because of the die-back that appeared in every tree thus fertilized. The trees had not recovered at the time of our visit.

(*d*) The excessive use of blood and bone or other commercial fertilizers rich in nitrogenous elements seems to stimulate the disease.

(4) *Remedies.*—Almost as general as the belief in the cause or occasion of this disease is the belief that the most effectual remedy is to let the affected trees entirely alone. The cessation of cultivation and heavy fertilizing will remove the disease even in bad cases. We noticed trees, which two years ago produced no fruit, because of the severity of the disease, that were sufficiently restored to produce a half crop or more during the present season, with no other treatment than that above mentioned.

II.—FOOT-ROT.

(Gum disease, *mal di goma.*)

(1) *Nature of the disease.*—This disease has long been known in Europe and has also given rise to some investigations in this country. Mr. A. H. Curtiss has quite fully described the disease, and we quote from his description:

The prominent symptoms are exudation of a gummy or sappy fluid from near the base of the trunk, and decay of the bark in that region and of the roots below. The flow of gum and attendant decay of the tree extend upward and in a lateral direction until the tree is girdled, also penetrating successive layers of wood. In some cases gum exudes from cracks in various parts of the trunk or even on the branches, and in others the decay progresses without emission of gum. Attendant or premon-

itory symptoms are excessive and rather late blooming, the flowers being small or mostly unfruitful, and arrested and unnatural development of the foliage, which becomes yellow and drops.*

We could gain no evidence of its contagious nature. A résumé of information concerning this disease has been already published from the Department,† and only such additional or conflicting information as we have gathered will be here given.

(2) *Distribution.*—Like the preceding disease, foot-rot is not confined to particular localities, but has a wide distribution. Bad cases occur at various points throughout the orange belt; it is more serious in the older trees, rarely appearing in trees less than 12 or 15 years old. In many places, especially in young groves, it is just beginning to appear, but has not yet attracted the attention it merits, for as groves grow older and present methods of fertilization continue it is likely to prove still more injurious and destructive. Contrary to popular and published opinion, it is not confined to sweet seedlings. We have seen bad cases in large sour stock budded 2 or 3 feet above ground, in the grape fruit, and even in the lemon.

(3) *Causes.*—Nothing has come to light that settles upon any definite cause for the disease. From all that can be learned, however, it would seem that the cause is to be looked for in the defects of cultivation and fertilization rather than in any bacterial or fungous parasite. Some maintain that it is of a similar nature to die-back and is occasioned and cured by the same treatment. There is no visible proof of this statement and no facts to illustrate any genuine cures, as in the case of the former disease; it is doubtful if more than temporary relief can be gained by this method, for when the disease is well established in the tree it is almost certain to girdle it in time in spite of any treatment yet discovered.

(4) *Remedies.*—Sweet seedlings affected by this disease are frequently assisted by planting one or more stands of sour nursery stock near the root and budding several branches into the trunk above the infected portion. This at best can furnish only temporary and partial relief, for the disease is likely to spread too rapidly in the main trunk to allow the budded support time to furnish sufficient nourishment for the tree before its own supply is cut off, or the sour stocks are likely to be ultimately affected themselves.

Exposing the crown roots is another method of treatment in favor in certain parts. As a preventive it is more likely to be successful than as a cure, but it is doubtful if this method will be of any permanent value and there is some liability of its proving an injury to the trees in other ways. One method of treatment connected with the manner of cultivating the trees seems worthy of trial: Cultivate sparingly, fertilize more sparingly, and apply no fertilizer nearer than 6 or 7 feet

* Bulletin No. 2, Florida Agr. Experiment Station, 1888.

† U. S. Department of Agriculture, Botanical Division, Bulletin No. 8, pp. 51–54 (1889).

from the trunk of the tree. In addition a study should be made of the relative adaptability of the various fertilizers to the particular soil. This is properly the function of public experimenters, but much can be accomplished by individuals if sufficient care is exercised. In one of the finest groves visited the principal fertilizer used consisted of decaying vegetable rubbish piled between the rows of trees. Weeds were allowed to grow in the intervening spaces thus covering the light-colored soil, and preventing much of the undue reflection of light and heat that is so common where clean culture is practiced.

III.—BLIGHT.

(LEAF CURL, WILT, GO-BACK.)

(1) *Nature of the disease.*—The leaf blight, leaf curl or leaf wilt, as it is variously called, first makes its appearance on certain branches, and may be recognized by the curled or wilted appearance of the leaves, which also turn a sickly yellowish color and after a short time drop from the tree. The twigs at the ends of the branches also die, and if new ones appear they soon present the same sickly hue; the bark, especially on the upper side of the branches, becomes "hide-bound," and later splits open on either side, leaving a dead space between the ruptures. The fruit grows smaller, but is otherwise not affected. Gradually other branches become infected, and if the tree is left to itself it finally dies down to the root. As the disease progresses new shoots constantly make their appearance below the infection, appearing robust at first, but as the infection descends they too become wilted, and finally those only appear healthy that spring from the root. If the tree is vigorously pruned at the first appearance of the disease and well fertilized, it will apparently recover, but after a little will relapse or go back to its former condition. This peculiarity of the disease has given rise to to a popular name which it does not seem desirable to perpetuate.

The disease does not seem to attack trees before they reach maturity, or before they are 10 or 12 years old. When one tree becomes attacked, adjoining trees, either during the same season or more likely during the following season, will be affected, so that the diseased trees appear in groups. Sporadic cases occasionally occur, but the above condition is so nearly universal as to make it extremely probable that the disease is contagious.

(2) *Distribution.*—Bad cases of this disease are found as yet in only a few localities where the orange groves have long been established. While it is evidently not a new disease its ravages have only recently extended sufficiently to give alarm to cultivators. All things considered, this disease is the most dangerous that has yet appeared among the orange groves, and a study of its causes and cure demands immediate attention.

(3) *Causes.*—Nearly as many causes are assigned for the disease as there are cultivators whose groves are affected by it. Some assign it

to the decay of tap roots and others to the tap root coming in contact with hard pan or underlying rock formation. To test this the tap roots of certain infected trees were exposed and examined. The tap root extended about 4 feet in one case and between 8 and 9 feet in another, and in every case had not extended below the sandy soil and were apparently healthy. Some attribute it to overbearing; still others, to some peculiar oiliness of the soil which prevents it from becoming thoroughly wetted. In regard to this we may state that, while the surface is usually very dry in most locations, the subsoil in all the examinations made on infected trees was wet and in one case water accumulated in the excavation at a level only a foot below the extremity of the tap root. Others liken the disease to pear blight. It differs, however, from that disease, in extending to parts of the same tree much more slowly and in spreading to trees adjacent to the center of the infection only after a considerable time, usually after the interval of a season's growth.

From all the evidence gathered in the field we incline to the belief that this disease is bacterial in its nature, and while the evidence is so scanty as only to create an *impression* it is strong enough to recommend investigation in the direction of this theory. With sufficient time (because the action of the disease is rather slow) a skilled experimenter could doubtless prove its nature to be bacterial, if such be the case. The other causes assigned and probably still others connected with the methods of cultivation, and possibly some climatic conditions, may indirectly encourage the spread of the disease by furnishing conditions under which the tree can not successfully resist the attack of the disease. It is well known, but too often not sufficiently taken into account, that certain physiological conditions render trees subject to ravages of disease, just as among men and other animals, and often a disease may be warded off by keeping the tree in the proper condition of vitality, more easily than it can be cured if once the disease has taken possession of it.

(4) *Remedies.*—There is little to say under this head at present. The following methods have been tried, but with indifferent success:

(*a*) Prying up the trees, so as to raise the roots from the "hard pan."
(*b*) Cutting back the branches and fertilizing heavily.
(*c*) Trimming off affected branches and burning them.
(*d*) Trimming back branches, trenching at a distance of six or eight feet from the tree, so as to cut back roots proportionally, followed by heavy fertilizing.

In addition to the above, a rather unique method of treatment was applied by the advice of a dealer in a commercial fertilizer "specially adapted to the cure of diseased trees." This consisted of cutting back all the branches of the tree to within two or three feet of the trunk, smearing the cut ends of the branches with coal tar as a preventive against the ravages of the "crown borer,"* and then smearing the entire

* *Elaphidion inerma* Newman.

trunk with a paste made of clay, lime, sulphur, and "chips" (dry cow manure). At the time of our visit the application had only recently been made, so we were not able to see the results. It can hardly be expected that such a treatment will prove beneficial. The same dealer claims to have cured a number of trees in that way, but at the time of our visit to his place he was absent from home and we were thus unable to sift the evidence.

IV.—SCAB.

(1) *Nature of the disease.*—This disease first makes its appearance in the form of whitish or cream-colored spots, more commonly on the under side of the leaf but often on the upper side and occasionally on the young twigs and fruit. Those on the leaf are often accompanied by a depression or pit on the opposite side. These spots grow larger and often coalesce; ultimately they turn dark, and if abundant the leaf becomes badly curled, twisted, or otherwise distorted and more or less covered with the wart-like eruptions which the disease has developed.

(2) *Distribution.*—The disease is widespread; in a few localities it does not seem to be regarded as anything serious. In other localities, where it is more abundant, it is becoming the source of much alarm. It is not confined to young trees, but attacks equally young and old stock. While more abundant on the wild orange it is by no means confined to it, nor even to sour stock. We saw it on wild orange trees very commonly, on grape fruit and lemon trees frequently, and on sweet orange trees rarely.

(3) *Causes.*—Prof. F. L. Scribner, who made a study of this disease in 1886,* attributed it to a parasitic fungus (a species of *Cladosporium*), whose growth in the tissues of the leaf produced the distortions and saps its vitality. Our own observations confirmed these conclusions.

(4) *Remedies.*—In the paper above alluded to Prof. Scribner makes the following recommendations for spraying mixtures: (*a*) A solution of potassium bisulphide, one-half ounce to the gallon; (*b*) liquid grison; (*c*) one-half pint carbolic acid and 1 pound of glycerine added to 10 gallons strong soap suds.

We could not learn that these remedies or any other treatment had been attempted in any of the orange regions visited.

V.—LEAF SPOT.

(1) *Nature of disease.*—On certain leaves of the orange, both wild and sweet, faded spots appear, varying in shape, but mostly rounded or oval, and in size from one-eighth of an inch to an inch in diameter. As the disease progresses, these spots become grayish brown and dead, and covered on one or both surfaces with a series of minute black points, which contain the fruit of the fungus, which is the cause of the disease.

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* Bulletin Torrey Botanical Club, XIII, 181-1-3 (Oct., 1886).

(2) *Distribution.*—This disease was found at only one point in Lake County. Dr. Martin found it in 1886 at Green Cove Spring. It does not seem to be widespread nor at present of much importance, but is recorded here that attention may be called to it, so that its nature may be known and its progress watched.

(3) *Causes.*—The cause of this disease is a parasitic fungus (*Colletotrichum adustum*, Ellis)* which draws the nourishment from the leaf it inhabits. It belongs to a group of fungi that are known to be imperfect forms, and are supposed to be a phase of growth in the life history of some mature form of fungus. The particular form of which this species is a phase of growth is not known nor even suspected. Its connections are to be looked for among some of the many species of ascomycetous fungi which inhabit decaying vegetable matter, and for this reason are supposed by the uninformed to be of no economic interest.

VI.—SOOTY MOLD.

(1) *Nature of the Disease.*—The leaves of certain trees badly affected with some kind of scale insects become covered with a sooty layer, which is of a dark drab or dirt color early in its growth and finally becomes sooty black. The layer thus formed is only loosely attached to the smooth surface of the orange leaf and frequently comes off in patches.

(2) *Distribution.*—This disease does not appear to be very widespread on the orange trees in Florida† and the material collected was young and immature. We found it, however, more abundant on *Magnolia fœtida*, *Smilax* sp., and other shrubs which were abundantly affected with scale insects.

(3) *Causes.*—In 1876 Dr. W. G. Farlow published an elaborate paper‡ giving a full account of this disease as affecting the orange and olive trees of California, and referring it to a fungus (*Capnodium citri*, Berk. & Desm.) which feeds on the honey dew produced by the bark lice. While the fungus draws no nourishment from the orange leaves themselves it must, if abundant, seriously interfere with the process of assimilation and therefore be regarded as injurious.

(4) *Remedies.*—In the paper above mentioned, spraying with a strong solution of alkali soap is recommended. The disease has not yet made sufficient progress in Florida to demand much treatment, and with the natural enemies of the scale insect to check their development is not likely to prove a serious difficulty.

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* Described as *Phyllosticta adusta*, E. & M., but Mr. Ellis (*In litt* 16 May, 1891) refers it to *Colletotrichum*.

† At Los Angeles, California, in 1886, we saw this disease in great quantity, entirely covering the leaves in some of the orange groves. With the disappearance of the scale insect the disease will disappear likewise.

‡ Bull. Bussey Inst. I, 404–414, 1876.

VII.—LEAF GLAZE.

The disease to which we have given the above name makes its appearance in the form of grayish flattened patches on the upper surface of the leaves. These are small and often clustered at first, but soon coalesce and become of considerable size. The spots are due to the growth of a lichen (*Strigula* sp. probably *S. complanata*, Fee.), which draws no nourishment from the leaves but, like the preceding disease, must interfere in a measure with the assimilation of the plant. Many other lichens and some scale mosses (Hepaticæ) are likely to accumulate on the trunks and branches of the orange trees where there has been careless management of the groves. Their presence is a disadvantage to the tree as harboring places for vermin, but they are much less likely to have any influence over the physiological functions of the tree than the present species. We are not aware that attention has been called to this source of trouble before in relation to the orange trees nor that any methods of treatment have been recommended for arresting the growth of the lichen. Tuckerman reports this species on Magnolia, and we found it abundant on Magnolia leaves in Lake County. The spots of growth on the orange were small and immature at the time of our visit, but as the rainy season advances they are said to increase in extent and often spread over considerable portions of the leaf.

OTHER FUNGI GROWING ON ORANGE TREES.

Only a few species of saprophytic fungi were found among the orange groves, growing on dead or dying trunks and on dead limbs and twigs. The two species of *Hypochnus*, whose systematic position is uncertain, grow on the trunks of living trees that are usually more or less covered with lichens and Hepaticæ. The following were found, some not being in a condition to be specifically identified: *Schizophyllum commune*, *Polyporus* sp., *Corticium* sp., *Hypochnus albo-cinctus*, *H. rubro-cinctus*, *Xylaria* sp., *Diatrypella citricola*, Ellis, n. sp., *Macrosporium*, sp., and some others of still more doubtful relations.

PEACH BLIGHT.

Monilia fructigena, Persoon.

By Erwin F. Smith.

(Plates V and VI.)

This note is for the purpose of calling renewed attention to the destructive action of *Monilia fructigena* upon the branches of the peach. It will serve to record some new facts and to correct one or two assumptions which found their way into a previous paper* without sufficient warrant.

* Journal of Mycology, vol. v, No. 3.

The vitality of the conidia is much greater than I had supposed. In one instance roll cultures from dry material a year old gave results, although only a portion of the conidia germinated. Spores from other samples failed to grow. More tests will have to be made before we have anything like an accurate measure of the vitality of the conidia, but it is probable that these alone are sufficient to tide the fungus over winter. There is, however, no question as to the existence of a resting mycelium within the mummified fruits. The sudden general appearance of the blight on the Delaware and Chesapeake peninsula this spring is a matter of special interest in connection with the fact that there was no twig-blight and no rot of the fruit in 1890. There was no fruit which could rot, owing to the destruction of the entire crop by spring frosts; and being in the orchards much of my time from April to November, I did not observe a single blighted twig, although anxious to collect it.

In the spring of 1891 the blight of the twigs of the peach was a common occurrence on the upper part of the peninsula, *i. e.*, in five or six counties. It attracted general attention and in Sussex County, where it was most injurious, it was named "the scald," and was very generally ascribed to the heat of the sun. In Maryland it was attributed to frosts.

Observations in many orchards showed that it appeared immediately after rain during the time of flowering, and that it penetrated *exclusively through the blossoms.* Heretofore I had supposed it capable of penetrating through the unbroken cuticle of young shoots, but such cases must be exceptional. An examination of hundreds of twigs in all stages of blight showed that every one was associated with blighted and persistent flowers. In a majority of cases the entire twig was killed, *i. e.*, the distal end beyond the point of entrance (Plate V, Fig. 1). The extremities of the twigs blighted either under the direct action of the mycelium or simply from arrested nutrition due to injuries farther down the stem. It was not difficult, however, to find cases (Plate V, Fig. 2) where only one blossom and a small portion of the adjacent stem was affected, the parts above and below remaining intact. The uniform persistence of the blossoms and the size of the twisted, withered leaves (Fig. 1) showed very clearly for many days that all the injury was done at one time. Some weeks later, under the influence of warm weather, many restricted blight spots, as in Fig. 2, took a new growth, girdling stems and wilting good-sized green leaves and fruits, but I looked in vain for new infections.

For 3 weeks following blooming the weather was dry and the blight was restricted almost wholly to stems of last year's growth. But I found a number of stems in which it had involved the growth of 1889, and saw enough to convince me that with wet weather and high temperature such cases would have been as common as in the summer of 1887, when the fungus entered the stems, by way of the rotting fruits.*

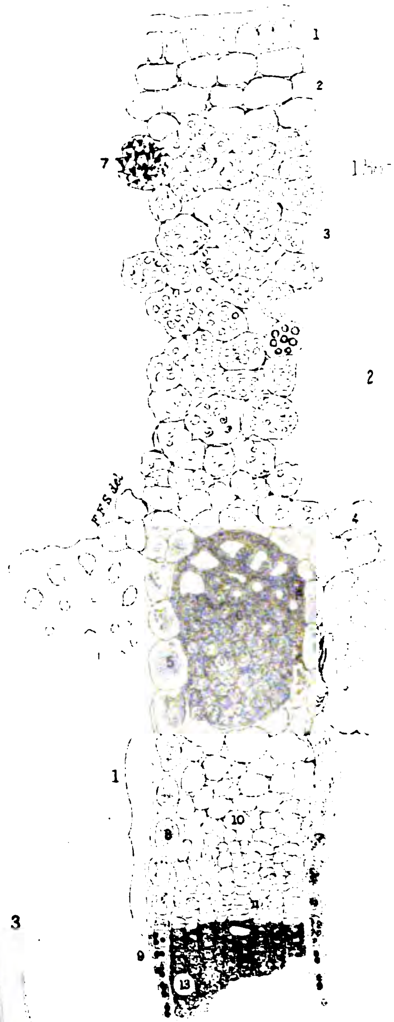
* This method of penetration was also common in Maryland and Delaware in the *summer* of 1891, and early varieties blighted almost as badly as in 1887.

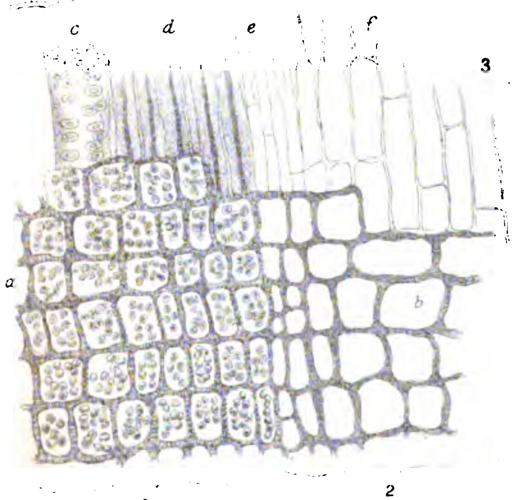
The dry weather also almost wholly prevented the fruiting of the fungus. Out of many hundred stems examined for spore tufts, during a period of 3 weeks following blossoming, I found only half a dozen. However, a microscopic examination showed the presence of mycelial threads in the tissues, and upon placing freshly gathered twigs in moist air for 12 hours many of them sent out the characteristic spore tufts of *Monilia fructigena.* By continuing this treatment another 12 hours spore tufts pushed through the unbroken bark on about 75 per cent of the stems. This experiment was repeated some days later with similar results, but a third experiment, using twigs which had been picked 4 or 5 days and were somewhat dry, gave only 2 per cent with *Monilia* tufts at the end of 24 hours. Plate V, Fig. 3, gives an enlarged view of a twig bearing fruiting tufts after 12 hours in moist air. Fig. 4 shows a conidiophore and conidia from the same.

The extrusion of gum from the vicinity of the blighted flowers was quite common (Plate V, Figs. 1*g* and 2*g*). On cutting through the bark of such twigs the vicinity of the cambium cylinder was invariably gummy, but this was less noticeable on dry twigs.

Carefully made cross sections of freshly blighted twigs were submitted to microscopic examination. The cambium and soft bast cylinders had disappeared almost completely with the formation of extensive gum pockets (Plate VI, Fig. 1). These pockets were full of the active mycelium of *Monilia.* This also penetrated into the cortical parenchyma to some extent, and to a lesser degree into the xylem. Practically speaking, the wood and pith and all of the cylinders external to the soft bast were intact. On unmagnified cross sections a zone of discoloration was visible between the wood and the bark. On magnification this was found to consist, as shown in Plate VI, Fig. 1, of a gum cavity containing mycelium and fragments of tissue and bordered by irregular dark zones, the one within composed of young wood and vessels laid down this spring, and the one without composed of remnants of soft bast and phlœm rays. The bundles of bast fibers were also changed from a glistening white to a dirty yellowish brown. Plate V, Figs. 5, 6, and 7, show mycelial threads from these cavities. It was easy to find threads overlying and interwoven with tissue. Plate VI, Fig. 2 represents the appearance of the destroyed tissues on a normal cross section; fig. 3 represents the same on a longitudinal radial section.

SMITH ON MONILIA FRUCTIGENA.





1'100 mm.

SMITH ON MONILIA FRUCTIGENA.

DESCRIPTION OF PLATES.

PLATE V.—(*Monilia fructigena.*)

Fig. 1. Blighted peach stem, showing dead persistent, flowers and leaves; *g*, gum exuded near union of blighted and living portion; *w*, stem of two year's growth. Collected some days after the entrance of the fungus.

2. Peach stem collected same day as Fig. 1; *a*, withered persistent flower through which the mycelium entered the stem; *bb*, restricted area of blight, the distal end of the stem being still connected by a narrow isthmus of sound tissue with the parts below; *g*, drop of exuded gum.

3. Enlarged end of blighted stem showing conidia tufts which pushed through the bark on exposure to moist air.

4. Conidiophore and conidia from one of the tufts shown in Fig. 3.

5 6, 7. Mycelial threads from the gum cavities of the inner bark. (See Plate VI, Fig. 1.)

PLATE VI.—(*Monilia fructigena*).

Fig. 1. Cross-section of a blighted peach stem, such as Fig. 1 of Plate V, showing a large gum cavity full of active mycelium; *p*. pith; *x*, xylem; *c*, cavity containing remnants of cambium and soft bast and hyphæ; *b*, bast bundles, *cp*, cortical parenchyma; *e*, epidermis. On the opposite side of this stem was a cavity larger than that here shown.

2. Enlarged cross-section of portion of a normal peach stem one year old, for comparison with Fig. 1. The portion destroyed is that included in the brace; (1) Epidermis; (2) subepidermal cells, usually destitute of chlorophyll, but containing coloring matters in solution, *e. g.*, reds or browns; (3) chlorophyll bearing cortical parenchyma; (4) expansion of phloem ray cells; (5) phloem ray cells separating bast bundles; (6) bast bundle—outlines of two others are indicated; (7) large cell containing a crystal of calcium oxalate; (8) phloem ray cells separating the soft bast (4, 5, and 8, destitute of starch); (9) xylem ray cells full of starch; (10) soft bast; (11) cambium; (12) xylem fibers; (13) vessels in the xylem.

3. Longitudinal radial section along the medullary ray of a stem similar to the inner part of Fig. 2, showing wood, cambium, and soft bast with an overlying portion of the ray. *a*, Cells of xylem ray gorged with starch; *b*, cells of phloem ray destitute of starch; *c*, pitted vessel; *d*, wood fibers; *e*, cambium cells; *f*, soft bast. The left part (1) is xylem; the right (2) is the inner part of the phloem, and is the portion destroyed by the Monilia. Sections from which Figs. 2 and 3 were drawn were cut from fresh material at the end of the growing season (November 1).

THE IMPROVED JAPY KNAPSACK SPRAYER.

By B. T. GALLOWAY.

(Plates VII-IX.)

Something over three years ago the Japy brothers of Beaucourt, France, designed a knapsack sprayer, which is commended by every one who has used it, for its simplicity, durability and effectiveness. This machine is used largely throughout the vine-growing region of France and a few have been imported into this country. Recently a number of improvements have been made in the sprayer which make it even more valuable, placing it, in fact, in the front rank of machines of this description. For the benefit of American small fruit and vegetable

growers, for whom this machine is especially adapted, we give below a full description of it, accompanied by illustrations.

As will be seen by consulting Plates VII–IX the machine in the main consists of a reservoir, pump, air chamber, strainer, lance, and spraying nozzle. The reservoir, with the exception of the bottom, is made of 16-ounce sheet copper and holds a little over 3 gallons. The bottom, to better withstand the strain put upon it when the pump is in use, is made of 20-ounce copper. It is further strengthened by soldering across it, inside the tank, two strips of heavy sheet copper, each 1½ inches wide and 4½ inches long. While speaking of the bottom it may be well to say that the wall of the reservoir projects in a rim beyond it a distance of 1¾ inches, as shown by the two dotted lines *a* and *b* in Fig. 1, *a* being the point where the bottom is placed and *b* the edge of the rim. Both top and bottom of the tank are soldered in and are provided in each case with two openings. The openings in the top, as shown by the black portions in Fig. 2, are for the introduction of the liquid and the piston rod, the small round opening serving for the latter purpose. The white portion *a* in Fig. 2 merely represents the top of the air chamber, which extends to within 1½ inches of the top of the tank. It will be understood, of course, that this opening, which is 4½ by 7⅝, is clear throughout, the top of the air chamber offering no obstruction whatever to the introduction of the liquid. Into the large opening is fitted a brass wire strainer having a number forty mesh. The strainer is shown at Fig. 4. It is made by simply soldering the brass wire already mentioned to a collar of sheet copper three-fourths of an inch in height. Across the strainer is soldered a narrow strip of copper or piece of heavy brass wire which serves the double purpose of a brace and handle. The strainer is made with a narrow flange at the top, in order that it may be held in place by a shoulder projecting from the edge of the opening in the tank. The opening is closed by means of a top, represented at Figs. 5 and 6. It is made of copper and is so simple in construction that further description is unnecessary. The two openings in the bottom of the tank are shown at *a* and *b* in Fig. 3. Into these is fitted the combined pump cylinder and air chamber, the ends *e* and *f* in Fig. 7 being the only parts that project outside the tank. By means of the two screw caps *a* and *b* in Fig. 3 the whole of this part of the machine is held firmly in place against the bottom of the reservoir, washers, of course, being used to prevent leakage.

Between the cap *a* and the tank there is fitted a small casting which serves to conduct the liquid from the air chamber into the hose shown at *c*, Fig. 3. The pump and air chamber are shown at Figs. 7 and 8, the plunger being removed from the cylinder merely to illustrate it more clearly. The air chamber *a* and the pump cylinder *b* are simply pieces of 2½ inch brass pipe 12½ and 4⅝ inches long respectively. Both are soldered to the casting C, a bottom view of which is shown at Fig. 9. The top of the air chamber is closed by means of a cap of heavy sheet copper *d*, soldered as firmly as possible to the brass pipe. The plunger

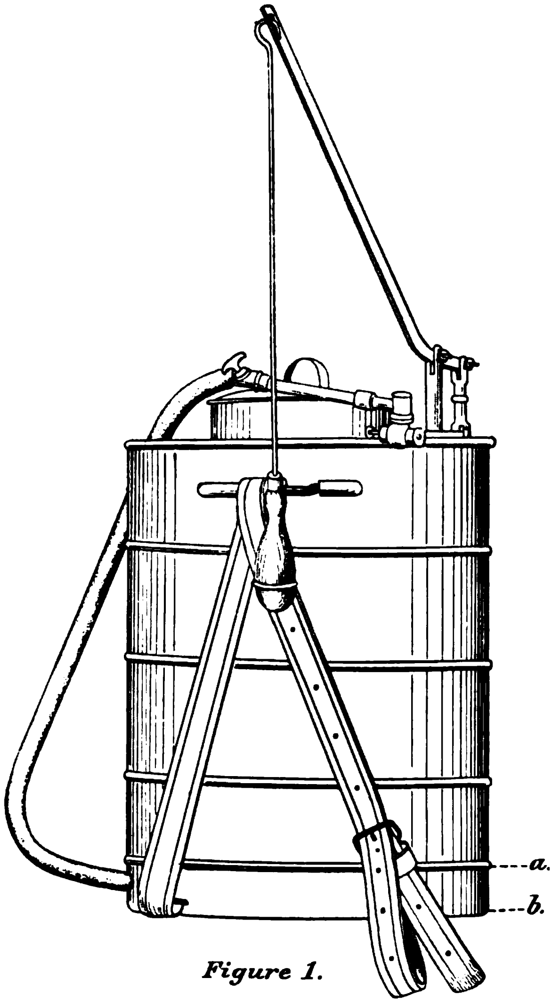


Figure 1.

GALLOWAY, ON AN IMPROVED JAPY SPRAYER.

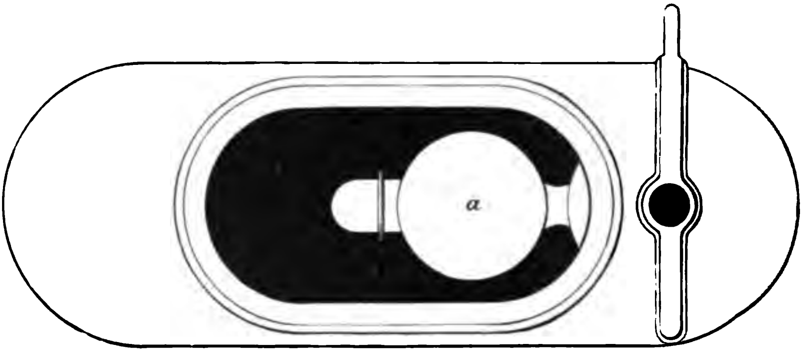


Figure 2.

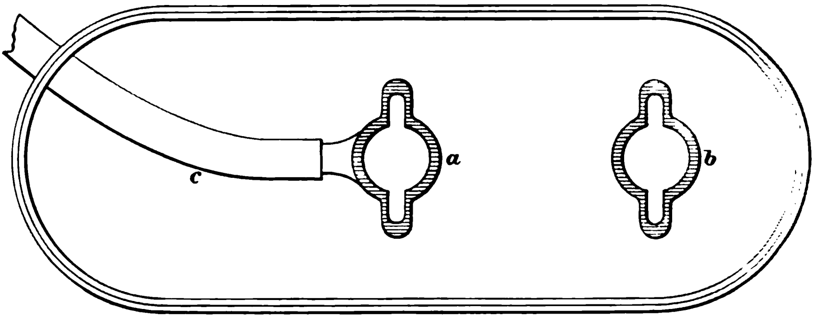


Figure 3.

Figure 4.

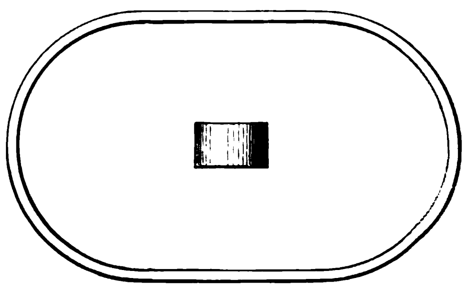


Figure 5.

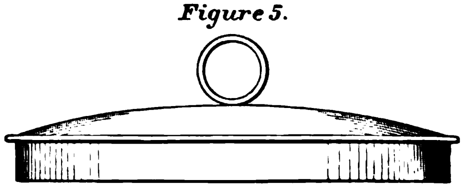


Figure 6.

GALLOWAY, ON AN IMPROVED JAPY SPRAYER.

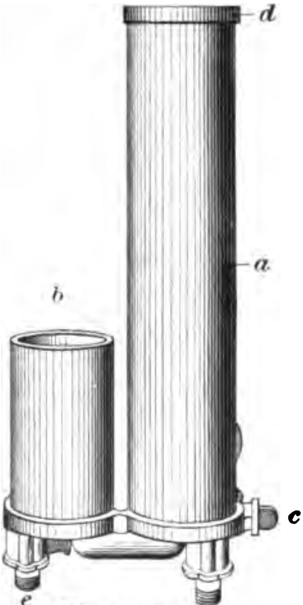


Figure 7.

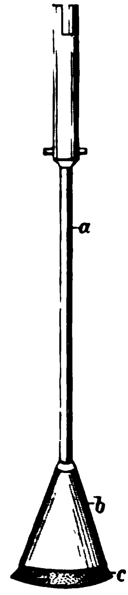


Figure 8.

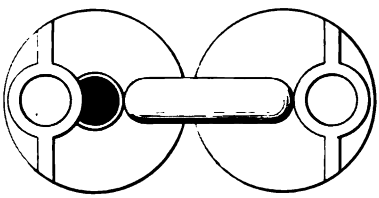


Figure 9.

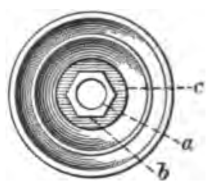


Figure 10.

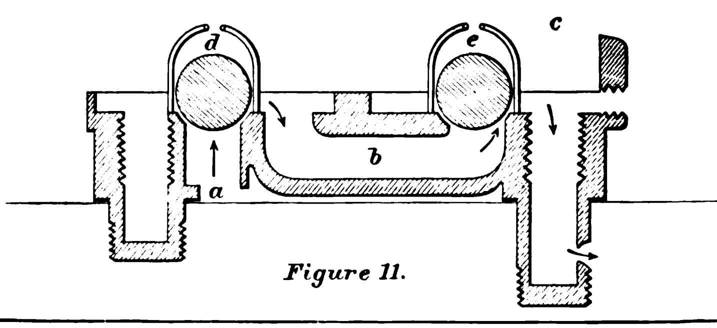


Figure 11.

GALLOWAY, ON AN IMPROVED JAPY SPRAYER.

which works in the cylinder consists of a cone-shaped brass casting into which is fastened a similarly shaped piece of soft rubber, the base of the latter being a little larger than that of the former.

These various parts are all plainly shown at Fig. 8, *a* being the piston rod, *b* the cone-shaped brass receptacle for holding the piece of soft rubber shown at *c*. In Fig. 10 are shown the parts used in fastening the rubber to the brass cone, *a* being the end of the piston rod with screw thread, *b* tap, and *c* casting which fits between the tap and cone and holds the rubber in place. This casting is shown enlarged at Fig. 9. The manner of working the pump will be better understood by consulting Fig. 11 in which the flow of the liquid is represented by the arrows. When the piston is raised the liquid is drawn in at the opening *a*. The downstroke forces the liquid through the pipe *b* into the air chamber *c* and at the same time closes the ball valve *d*. Another upstroke is made and the ball valve *e* closes the opening at that point, thereby preventing the liquid from rushing back into the pump cylinder. This process being repeated the liquid remains under constant pressure in the air chamber and as a result it is forced through the hose, lance and nozzle shown in Fig. 1 in a constant spray. The lance and nozzle we use on this machine is the well known improved Vermorel. The other parts of the apparatus, such as the straps, handle, lever, etc., need no special mention, as any machinist will be able to see from the drawings how they are made and used. For the further benefit of any one desiring to manufacture the pump the dimensions of the various parts are given in detail at the close of the article.

As regards cost, the machine with two lances and nozzles sells in France for 40 francs, or about $8. The duty, transportation, and other charges on the pump will bring the cost, laid down in this country, up to about $20. This is for a single machine. Where a number are ordered at a time they can be delivered here for about $15 each. Estimating labor at 40 cents an hour the machine complete, as we have described it, can be made in this country for about $11.50.

If special appliances are used and the machines are turned out in large numbers, we see no reason why the actual cost of manufacturing could not be further reduced to $10.50 or even to $10 each. Manufacturing them at this price, it seems to us that they could be put on the market for $12 or $14 at a fair profit.

DIMENSIONS OF PARTS DESCRIBED ABOVE.

Reservoir, 17x13½x4½ inches.
Opening for liquid, 4⅛x7⅝ inches.
Opening for piston rod, ⅝ of an inch in diameter.
Opening for introduction of air chamber (*a* and *b*, Fig. 3), ¾ inch in diameter.
Strainer, ⅝x4⅛x¾ inches.
Air chamber, 2½x12½ inches.
Pump cylinder, 2½x4⅝ inches.
Diameter of piston rod at top, ½ inch.
Length of piston rod, 13½ inches.
Diameter of cone-shaped casting (Fig. 9), 2½ inches.
Height of cone-shaped casting, 2 inches.

NOTES ON SOME UREDINEÆ OF THE UNITED STATES.

By P. Dietel.

In a recent number of this journal Mr. Anderson has stated that *Uromyces sophoræ*, Pk., and *Uromyces hyalinus*, Pk., are identical, but erroneously says that they are referable to *Uromyces trifolii*, (Hedw.) Lév. In the latter fungus the same morphological characters are constant in both the American and European specimens, viz, dark brown teleutospores with a minute hyaline papilla; the latter often wanting. On *Sophora sericea* the spores are lighter in color and the papilla is very broad. There is still greater difference between the two species as regards their biological properties. Teleutospores only have been found on *Sophora*, and the fungus seems to hibernate by its mycelium. The affected plants, therefore, can be distinguished from the healthy ones by their slenderer growth. In the majority of specimens I have seen the sori appear on all the leaves of the plant, the youngest as well as the fully developed ones. *Uromyces hyalius* differs also from *Uromyces glycyrrhizæ*, (Rabh.) Magn., lately described by Prof. Dr. Magnus in the "Berichte der Deutschen Botanischen Gesellschaft." This fungus occurs in America on *Glycyrrhiza lepidota* and greatly resembles *Uromyces trifolii*, in its morphological characters, differing from it, however, by the perennial mycelium of the primary uredo stage and the absence of the æcidial fructifications.

In Hedwigia, 1889, p. 23, I have stated that *Uromyces caricis*, Pk., on *Carex stricta* is the Uredo of a Puccinia, which I have named *Puccinia caricis-strictæ*. As Prof. B. D. Halsted notes in the Journal of Mycology, vol. 5, p. 11, he has also seen the Puccinia, but considers it as a two-celled form of a normal Uromyces. But there can be no doubt that the so-called Uromyces is really the Uredo of the Puccinia, because it has four equatorial germ pores. *Uromyces perigynius*, Hals., is, however, a true Uromyces but the spores do not measure, as the author states, 4–6 by 8–10μ but 13–20 by 26–36μ.

Puccinia vernoniæ, Schw., is considered by most mycologists as a variety of *Puccinia tanaceti*, DC. or *P. helianthi*, Schw.; or as identical with *P. hieracii*, (Schum.) Mart. [*P. flosculosorum*, (Alb. & Schw.) Roehl]. A comparative examination of these species has shown that it is sufficiently different from any of them to constitute it a good autonymous species. It differs from *Puccinia hieracii* principally in having a much thicker epispore and frequently a thickening at the apex. In *P. helianthi* and *P. tanaceti* the teleutospores have a firm stalk and are clearly constricted at the septum, in *P. helianthi* more than in *P. tanaceti*. In the latter the spores, when examined dry, are beset with minute tubercules, in *P. helianthi* they are entirely smooth. The membrane of *P. helianthi* is thicker than that of *P. tanaceti*. *P. vernoniæ* has somewhat smaller spores than the two former species. They are usually not at all or only very little constricted at the septum, the membrane is beset

with tubercles and is even thicker than that of *P. helianthi.* The stalk is rather evanescent; its length differing on the different host plants. On *Vernonia fasciculata*, as has been stated by Professor Burrill, the length of the stalk is about four times that of the spore; on *Vernonia Baldwinii* it is much shorter, attaining only once or one and a half times the length of the spore. We might, therefore, distinguish two varieties of *P. vernoniæ* and designate the one on *Vernonia fasciculata* as var. *longipes*, the other on *Vernonia Baldwinii* as var. *brevipes*. I have not been able to examine this fungus on other host plants.

LEIPSIC, GERMANY.

NEW SPECIES OF UREDINEÆ.

By J. B. ELLIS and S. M. TRACY.

PUCCINIA HEMIZONIÆ, *n. s.* II, III.—Amphigenous; spots yellowish, rather large; sori small, scattered or sometimes confluent, surrounded by the remains of the ruptured epidermis; uredospores subglobose to oval, very slightly echinulate, thick walled, dark colored, 16–2 by 24–30μ; teleutospores obovate, occasionally three-celled, slightly constricted, apex much thickened, rounded or blunt pointed; epispore smooth, 22–24 by 45–48μ; lower segment lighter colored and tapering below to the flexuous, hyaline pedicel which is more than double the length of the spore. On *Hemizonia truncata*, Oregon.

ÆCIDIUM OLDENLANDIANUM, *n. s.*—Hypophyllous; æcidia few in a cluster, 80–100μ in length, the mouth but little split and not recurved; spores globose or sometimes slightly angled; epispore thin, smooth, bright yellow; 14–16μ. On *Houstonia cœrulea*, Starkville, Mississippi, April, 1888. Although the name "Oldenlandia" is obselete as applied to this host, the name given to this Æcidium on account of the name "houstoniatum" being already occupied by the *Æcidium houstoniatum*, Schw., from which this differs in the longer, narrower æcidia, smooth spores, and spermogonia rare or wanting.

ÆCIDIUM MALVASTRI, *n. s.*—Hypophyllous; spots light yellow; æcidia clustered, somewhat circinate, short, the spreading border rather narrow, spores subglobose or ovate, epispore thin, minutely tuberculate; 15–18 by 18–22μ; spermogonia unknown. On *Malvastrum Munroanum*, Albuquerque, New Mexico, Tracy, June, 1887.

NEWFIELD, NEW JERSEY.

A NEW PINE LEAF RUST.

(*Coleosporium pini*, n. s.)

By B. T. GALLOWAY.

Early in May of the present year we found on the leaves of *Pinus inops*, near Washington, a *Coleosporium* which appears to be new, and which may be briefly characterized as follows:

COLEOSPORIUM PINI, *n. s.*—III Amphigenous. Sori reddish orange, 1 to 5^{mm} long, or when confluent frequently attaining a length of 10^{mm} or more; spores irregularly clavate, smooth, 2 to 4 celled, 70–125 by 18–25μ. Forming yellow spots 4 to 25^{mm} or more long at or near the ends of *Pinus inops* leaves. The spores germinate readily in moist air by sending out one unseptate promycelium from each cell; upon the free ends of these tubes, which are of various lengths, the orange red sporidia are borne. Finding the *Coleosporium* nearly always associated with *Peridermium cerebrum*, Pk. led me to believe that it might be the teleutosporic form of this fungus. Cultures are being made to settle this and other questions connected with these interesting parasites, but as it will be at least a year before definite results can be obtained we have thought it best to briefly describe the *Coleosporium* here.

OBSERVATIONS ON NEW SPECIES OF FUNGI FROM NORTH AND SOUTH AMERICA.

By Prof. G. LAGERHEIM.

A NEW HOLLYHOCK RUST.

(Plate X.)

The Hollyhock (*Althæa rosea*) has several enemies among fungi. The most dangerous diseases of this ornamental plant are, as far as known, caused by *Puccinia malvacearum*, Montagne; *Cercospora althæina*, Sacc.* Recently Miss Southworth has directed attention to a new and dangerous disease of the Hollyhock caused by *Colletotrichum malvarum*,† (Br. & Casp.) South.

In the following lines I will describe a new Hollyhock disease caused by a fungus closely allied to and fully as dangerous as *Puccinia malvacearum*, Mont. As *P. malvacearum* has found its way from South America to Europe, it is not impossible that *P. heterogenea*, n. s., may also attack the Malvas of the Old World.

More than a year ago, while passing over the road between Guayaquil and Quito for the first time, I observed at several stations, viz, Chimbo, Guaranda, Mocha, etc., a rust on Malva which presented considerable

* B. D. Halsted, Garden and Forest, March 26, 1890.

† E. A. Southworth. A New Hollyhock Disease. Jour. Myc., VI, No. 2, p. 45, Plate III.

microscopic likeness to *Puccinia malvacearum*. Since *P. malvacearum* originated in South America, I supposed I had found the fungus in its native place. Arriving at Quito, I found the same fungus everywhere on different species of Malva and on Hollyhocks, to which it was apparently very injurious. I soon learned from several gardeners that Hollyhocks did not thrive well in winter and often perished from a disease which manifested itself by large numbers of brown spots on the leaves and stems. I was also shown some of these diseased plants bearing the brown spots, in which I immediately recognized my *Puccinia* on *Malva*.

It struck me, however, that the sori were in general distinctly larger than those of *P. malvacearum*, which I have observed in several places in Europe, and therefore I made a microscopic examination. To my astonishment I saw at the first glance that the fungus was not *P. malvacearum*, Mont. at all, but an entirely different Puccinia. It more resembled *P. heterospora*, B. & C., and at first I thought I had this species before me, but on a closer comparison of the two fungi it soon became apparent that the fungus was also very clearly distinct from *P. hetero spora*, B. & C., and must be looked upon as a new species.

On account of a peculiarity of its spores, which will be alluded to directly, I have called the fungus *Puccinia heterogenea*.

The fungus is found during the entire year on *Malva nicæensis*, *M. crispa*, *M. Peruviana*, and *Althæa rosea*,* and is especially plentiful in winter (January to May), but it could never be found on several Sida species which grew in the immediate neighborhoood of the diseased Malvas. It occurs on all the green parts of the plant, especially on the leaves; on these it is almost exclusively on the under side, while on the upper side it causes roundish, strongly concave spots, which are reddish in the center and yellowish at the edges. The sori are about a millimetre in diameter and are crowded together, forming a large, strongly projecting, chestnut-brown cushion several millimetres in diameter; and on the thicker portions of the stems they are more than a centimetre long and a half centimetre broad. Around the spore masses and between the single sori are visible shreds of the ruptured epidermis of the leaf. The sori contain only teleutospores, which under proper conditions germinate immediately after ripening; the fungus, therefore, belongs to the class *Leptopuccinia*. The teleutospores occur in two forms, one-celled, which is the preponderating kind, and two-celled. The one-celled spores (Figs. 10–13) are roundish ovate, elliptical, or elongated, 30–45μ long, and 20–30μ broad; the two-celled spores (Figs. 6–9) are elliptical or ovate above, rounded or tapering below, and little or not at all constricted in the middle. The membrane of the spore is yellowish, little or not at all thickened at the apex of the spore and perfectly smooth. The germ pore of the upper half of the spore

*I have also seen the fungus in a botanical garden of this country very abundant on a Malva grown from European seed, but unfortunately not definitely determined.

lies at the apex and that of the lower half close to the dividing wall, as appears to be the case in nearly all Leptopuccinias. The pedicel is very long, three or four times as long as the spore, and nearly hyaline. The spore contents are reddish.

Among the species of Puccinia occurring upon the Malvaceæ (*P. sherardiana*, Kornicke; *P. lobata*, B. & C.; *P. abutili*, B. & Br.; *P. carbonacea*, Kalchbr. & Cke.; and *P. heterospora*, B. & C) only one, *P. heterospora*, B. & C., resembles *P. heterogenea*. Both species have this in common, that they have one-celled as well as two-celled teleutospores; but in other respects they are entirely different. In the two-celled spores of *P. heterospora* (Figs. 4, 5) the septum occupies very different positions, while in *P. heterogenea* it always has its normal position (Figs. 6–9). In *P. heterospora* the two celled spores occur very rarely, while in *P. heterogenea* they are very frequent. The differences come out very sharply when the two species are examined mingled together in the same preparation. Even macroscopically the two species can be easily distinguished from each other. In *P. heterospora* the single sori are smaller and darker colored and stand very many together. Finally there is a difference in the choice of host plants of the two species. *P. heterospora* attacks mainly species of *Sida* and *Abutilon*,* and not *Malva*. With *P. heterogenea* the opposite is the case. *Puccinia heterospora* appears to prefer a tropical or subtropical climate, while *P. heterogenea* has up to this time been found only in regions with a temperate climate. On this account it is not impossible that *P. heterogenea* may occur in North America or in Europe.

The germination of spores takes place very rapidly. Fresh masses which had been kept in a moist chamber produced promycelia and sporidia from almost all their spores in a few hours. The promycelium divides into from four to six cells, the lowest one of which soon loses its contents and is incapable of further development (Figs. 14, 15). The formation of sporidia takes place in the manner typical of the Leptopuccinias. In very moist air the promycelium often falls apart into single cells (Figs. 17, 18). The process of germination is quite different when the spores are in water. They then germinate exactly like uredospores; a long, non-septate germ tube, often bent backward and forward, and with a strongly undulating contour, (Figs. 19–21), grows out of the germ pore. Occasionally the commencement of branching has been observed at the end of the germ tube (Fig. 21). Probably the fungus can reproduce itself by these germ tubes, which, because they form no sporidia, penetrate directly into the leaf. But it is clear that this method of reproduction is of much less importance than reproduction by sporidia. At the most, each spore can produce two germ tubes, and these can only penetrate into the same leaf

* Compare Seymour, Distribution of *Puccinia heterospora* (Journal of Mycology, Vol. I, p. 94). In previous years in Jamaica I found the species on *Abutilon indicum* *A. periplocifolium*, and *Sida ciliaris*.

or one very close to it, because they are attached to the germ tube of the spore, and the spore itself does not become separated from its pedicel. If, on the contrary, the spore germinates in the air numerous sporidia are formed, which may be carried away by the air, etc., and will spread the fungus far and wide. In consequence of this it follows that it is of great advantage for the fungus that the sori should break out on the under side of the leaf. If they made their appearance on the upper side they would be wet by the rain and germinate by germ tubes. The different modes of germinating above described (which I have, moreover, noticed for other Leptopuccinias*) explains why nearly all Leptopuccinias form their sori mainly or exclusively on the under sides of the leaves. What the cause (light?) of this is remains to be ascertained.

A description of this species is given below: *Puccinia* (lepto) *heterogenea*, n. s. P. maculis epiphyllis rotundatis vel rotundato angulatis, medio purpureis lutescenti marginatis concavis; soris teleutosporarum hypophyllis vel caulicolis, pulvinatis, prominulis, congregatis, castaneis, mox nudis; teleutosporis continuis vel bicellularibus, ovoideis, oblongis, vel ellipsoideis apice et basis rotundatis vel parum attenuatis, membrana levi, luteola ad apicem paullulum vel non incrassata et pedicello hyalino teleutospora 3–4-plo longiore, persistente præditis. Long. teleutosp. 30–60μ; lat teleutosp. 20–30μ.

Hab. in foliis et caulibus vivis *Althææ rosæ*, *Malva crispæ*, *M. Peruvianæ*, *M. nicæensis* ad Quito, Mocha, Chimbo, Guaranda et aliis locis Æquatoriæ.

A NEW COTTON RUST IN ECUADOR.

Cotton, like other cultivated plants, is attacked by different kinds of fungi. Atkinson has recently described a new *Ramularia* on *Gossypium herbaceum* in Alabama. It is striking that up to this time no Uredineæ have been observed on the cotton plant, as the Malvas belonging to the same family are attacked by numerous species of rusts. This I think justifies the publication of a new Uredo on Gossypium, especially as the disease thus caused is very injurious, and the cotton one of our most important cultivated plants. I discovered the fungus in the following manner: On December 10 of the preceding year I took a trip from Quito to Guayaquil to study the fungi and algæ of the tropical region. By December 15 I had arrived at Balsapamba (Province of Los Rios), in the tropical region on the Rio Crystal, where I stopped for a day. The owner of the "casa ponada," Senor Vasquez, took me around his plantation of coffee, oranges, and pineapples, and in the pineapple garden I noticed the diseased cotton plants. Senor Vasquez had planted here some of the shrub-like Gossypium, ordinarily planted in the equatorial coast region, and which yields large crops of good

* The same thing appears in Gymnosporangium. Compare Kienitz-Gerloff in Botanische Zeitung, 1888, p. 389, and Richards in Bot. Gazette, 1889, No. 9.

cotton. But he complained that his plants were diseased and only yielded a little cotton. In fact, the bushes with their dead and fallen leaves presented a very sorry appearance, and even the leaves that were still green were apparently attacked by a disease which showed itself in the form of very numerous small spots. I took a few leaves with me, believing it was a Sphæriacea or Sphæropsidea which had attacked the green parts of the plant. A few days later, when I arrived in Guayaquil, I examined the fungus microscopically, and was very much surprised when I found it to be a Uredo. On my return to Quito I stopped at Balsapamba to collect more of the fungus, but the disease had advanced so far that nearly all the leaves had fallen off and were destroyed. The rainy weather at the end of December and the beginning of January had apparently favored the growth of the fungus very much.

I will pass now to a more exact description of the fungus. As has been said, it affects all green parts of the plants. On the upper side of the leaves it produces small, purplish brown, roundish, or angular spots, either scattered or confluent in larger spots. The attacked leaves dry up and become brown. The sori are at first covered by the epidermis, and afterward break through on both sides of the leaf, especially on the under side. In structure the sori correspond perfectly to the Uredo of a Puccinia. The spores are not surrounded by a pseudo peridium, and are formed singly on pedicels. They are oval, ovate, or pear-shaped, with a thin, uniform, shiny, light yellow membrane and colorless contents. Their length is 24–30μ and their breadth 15–18μ; club-shaped paraphyses are present. The spores germinate in the ordinary manner. Whether this disease is limited to Ecuador or distributed elsewhere I can not now state. Cotton is now cultivated to a less extent than formerly on the coast and perhaps *Uredo gossypii* is the cause. Dr. Rimbach writes me from Cuenca that a cotton disease is known there under the name "Cancha." The name is also given to the diseases of potato, rice, coffee, bananas, etc., so that without the diseased cotton plants for examination it is impossible to say what it represents. Description as follows:

UREDO GOSSYPII, *n. s.*—U. amphigeni. Maculis parvis purpureobrunneis, sparsis vel confluentibus; soris præcertim hypophyllis, flavescentibus; sporis ovoideis, ovalibus, vel pyriformibus; 24–30μ longis, 15–18μ latis, membrana æquali, pallide flavescenti, echinulata, contentu achroo; paraphysibus claviformibus immixtis.

Hab. ad Balsapamba, Prov. de los Rios Æquatoriæ in foliis *Gossypii* sp., parasitica (Dec., 1890).

A NEW DOASSANSIA ON COTTON.

In a search to discover the teleutosporic form of *Uredo gossypii* I unexpectedly found a *Doassansia* on the cotton leaves. As the fruiting bodies of this fungus are not visible to the naked eye, they escaped me

before. So far as I am aware no Ustilagineæ have been observed on Malvaceæ, and on this account I think a short description of *Doassansia gossypii* will not be without interest.

The fruiting bodies form minute black points in the leaf substance. They appear to originate in the same way as Fisch* has described for D. *sagittariæ*, (West) Fisch. The ripe spores are oval, elongated, or pointed, 21–30μ long, 12–15μ broad, often somewhat angular and are firmly bound together. Their membrane is somewhat thick and of a slightly yellowish color, often rather strongly thickened at the corners of the spore. The outer cells are somewhat smaller than the spores, without contents, and with a brown membrane. This species has larger spores than any species of Doassansia known up to this time. Below is a description of the fungus:

DOASSANSIA GOSSYPII, *n. s.*—D. soris rotundatis punctiformibus, minimis, sparsis, atris sporis arcte conjunctis, ovalibus vel oblongis, 21–30μ longis, 12-15μ latis, episporio levi, dilute luteolo, tegumento communi e cellulis minoribus, membrana fusca, levi constituto.

Hab. in foliis Gossypii, spec. ad Balsapamba. Prov. de los Rios, Æquatoriæ.

A NEW PERONOSPORA ON GONOLOBUS FROM SOUTH CAROLINA.

While examining a *Leptopuccinia* collected on an Asclepiad at Quito, and comparing it with *Puccinia gonolobi*, Rav., I found a new Peronospora in considerable quantity on the specimens bearing this fungus (S. C. Mellichamp, Herb. Farlow).

The fungus forms large angular spots bounded by the nerves on the lower surface of the leaves. On the upper side they appear yellowish. The conidiophores are very slightly swollen at the base, several times dichotomously branched, with straight branches pointing obliquely upward. The lower part is 8.5–11μ in diameter. Its membrane is thin and colorless. The end branches are straight and conical, 6–9μ long. The conidia are roundish, ovate, with a pointed end and light violet gray membrane; their length measures 18–24μ and their breadth 16–21μ. I have not found oospores. The characteristics of the species are as follows:

PERONOSPORA GONOLOBI, *n. s.*—P. conidiophoris arborum modo repetite dichotomis ramulis rectis, membrana achroa, ad basim parum inflatis 8.5–11μ latis; ramulis terminalibus rectis 6–9μ longis; conidiis globoso-ovatis membrana pallide griseola 18–24μ longis, 16–21 latis; oosporis ignotis.

Hab. in foliis *Gonolobi* in South Carolina, U. S. parasitica.

QUITO, ECUADOR.

* C. Fisch, Entwickelungsgeschichte von *Doassansia sagittariæ* (Ber. d. Deutsch. Botan. Ges. Bd. II, 1884.)

DESCRIPTION OF PLATE X.

Figs. 1– 5. *Puccinia heterospora*, B. and C. The spore contents are not drawn with the same magnifying power.

6–21. *Puccinia heterogenea*, n. s.

1– 3. One-celled spores.

4– 5. Two-celled spores.

6– 9. Two-celled spores, of which 7 and 9 have germinated.

10–13. One-celled spores, of which 12 and 13 have germinated.

14. A one-celled spore which has germinated, and the promycelium divided into five cells.

15. A two-celled germinated spore; the promycelium has divided into four cells.

16. Sporidia.

17. A germinated spore whose promycelium has fallen apart into single cells.

18. Isolated cells of the promycelium.

19–21. Spores which have germinated in water and formed a long germ tube. In Fig. 21 the germ tube is branched at the end.

REVIEWS OF RECENT LITERATURE.

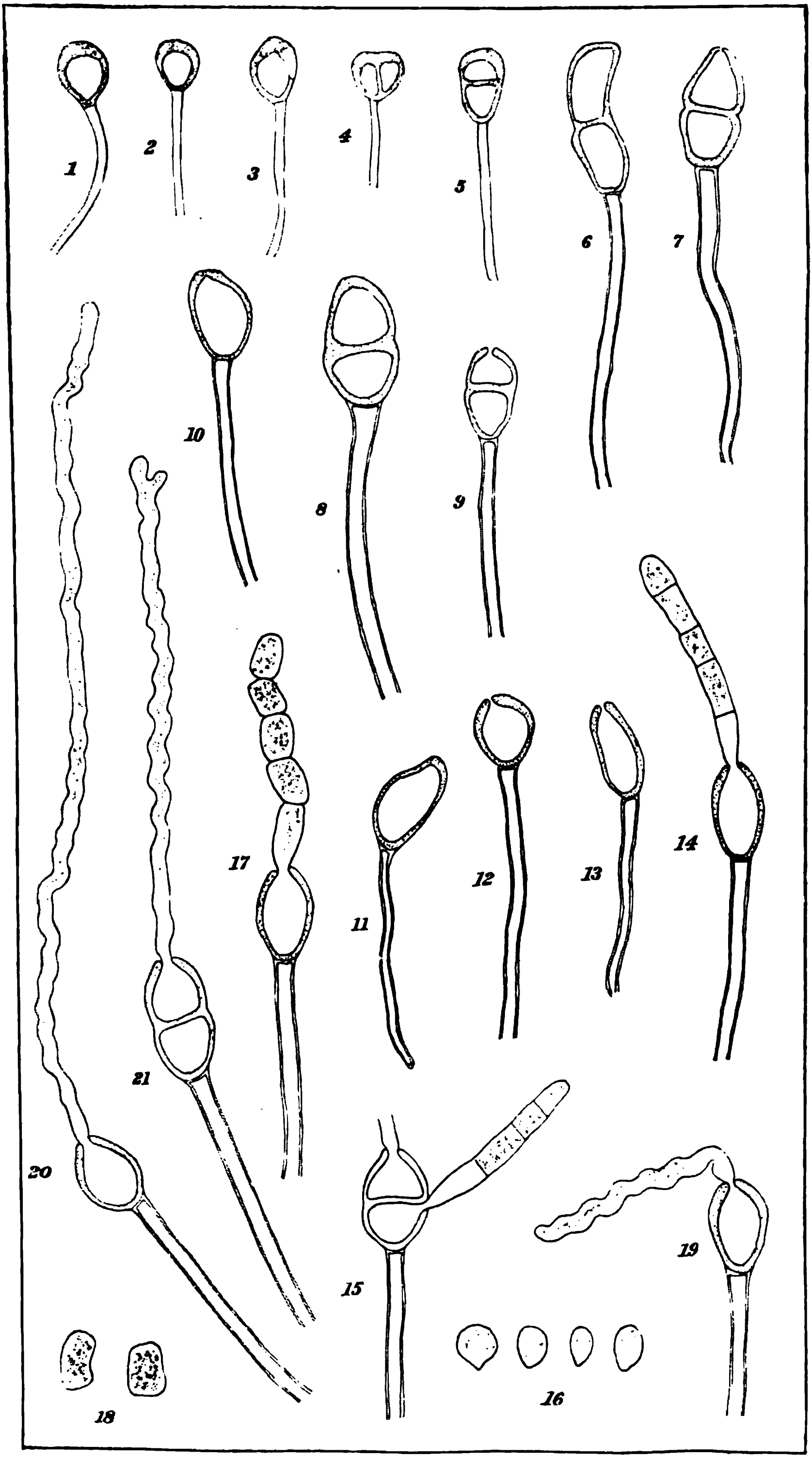
BREFELD, OSCAR.—*Untersuchungen aus dem Gesammtgebiete der Mykologie. Heft IX.* Munster i. W. 1891, pp. VIII, 156, pl. 4.

This indefatigable German botanist has recently given to the press the ninth part of the above work, and by this time no doubt has the tenth part before the public. These two parts represent 10 years of investigation, the last four of which have been entirely devoted to this work. Owing to the loss of one eye he has been obliged to have the constant help of an assistant, whose aid he acknowledges both in the prospectus and on the title page. The assistants in the work were Dr. Franz von Tavel and Dr. Gustav Lindau.

Dr. Brefeld feels that with the issue of these two parts and the plans of three more in hand, he can at least fully claim that he has laid the foundation for a natural system in the classification of fungi—a system which hitherto has made itself painfully conspicuous by its absence, and which can not be too warmly welcomed, or too thoroughly studied by American mycologists.

Part IX consists of five divisions. The first division is explanatory of the rest. The second takes up spermatia and their culture in nutrient solutions, shows that they are capable of germination and independent development and hence are a form of asexual reproduction distinguished from other spore forms only by their size.

Division 3 deals with the asci of Ascomycetes in their relation to basidia and simpler fruit forms. In this the author traces the relationship between conidia and sporangia and attempts to establish that the former is only a variation of the latter. Starting with these two he traces the



LAGERHEIM, ON A NEW HOLLYHOCK RUST.

development of sporangia to asci, and of the conidia through the simpler basidia forms to the more complex forms involved in the Basidiomycetes. The transition forms between the Phycomycetes on the one side and the Ascomycetes and Basidiomycetes on the other he uses to form a new class, the Mesomycetes, and divides it into the two parts Hemiasci and Hemibasidii. The fourth division is devoted to the former of these and treats *Ascoidea rubescens*, *Protomyces pachydermus*, and *Thelobolus stercoreus* in detail.

The Ascomycetes are further divided into the Exoasci and Carpoasci, and the fifth division takes up four species of the former. The Carpoasci are treated in part X.

The prospectus for these two parts also announces the subject matter for three more, one of which, the eleventh, is now nearly completed and will form a continuation of part V on the Ustilagineæ, which Brefeld ranks with the Hemibasidii.

Part XII will give his culture methods in detail, and XIII will begin the supplement to his earlier researches on the higher fungi.—E. A. SOUTHWORTH.

COMES, DR. O. *Crittogamia Agraria*. Naples, 1891. Pp. 600, pl. XVII.

This work, which has just been issued by Dr. Comes, will be of great value to American workers, especially as it brings together in convenient form the latest information on the plant diseases of a number of countries where the literature is scattered and hard to obtain. The first 15 pages of the book are devoted to a discussion of the effects of soil, air, temperature, etc., on vegetation. This is done, so the author states, to render what is said upon parasitic fungi more readily understood. After discussing the nature of parasitic fungi, polymorphism, germination of spores, classification, etc., the diseases of plants caused by the Peronosporeæ are taken up. Under this head a number of well known parasites, such as *Phytophthora infestans*, *Peronospora parasitica*, *Plasmopara viticola*, etc., are discussed. Following this are nearly 400 pages of observations on a long list of fungous diseases.

Chapter XXX, which opens on the 493d page, deals with the bacterial diseases of plants. Beginning with pear blight, the author discusses a bacterial disease of corn, mulberry, sorghum, potato, onion, hyacinth, pelargonium, pine, olive, and grape (stem). The tubercles found on legumes also receive considerable attention in this chapter. The volume concludes with a chapter on Myxomycetes and a good index.—B. T. GALLOWAY.

MORGENTHALER, J. *Der Falsche Mehltau, sein Wesen und seine Bekämpfung*. Zürich, 1891. Pp. 73, figs. 5.

German viticulturists have not as yet been obliged to combat the black rot fungus; but since 1880, when the downy mildew was first found in Switzerland, this latter fungus has gradually forced itself upon their

attention, and within the last few years some systematic attempts at treatment have been carried on.

The results of these experiments, as well as descriptions of the fungus, its history, and the history of the use of fungicides in Switzerland, together with modes of treatment and descriptions of spraying pumps, have been combined into a pamphlet of seventy-three pages, which will serve as an excellent handbook for the treatment of downy mildew. In this country, where mildew is one of the minor troubles of the grape-grower, and is always held in check by treatments for black rot, such a work would be of comparatively little use; but in a country where the question of conquering mildew is of paramount importance, it will be of great value to practical vineyardists. The descriptions of the fungus and methods of treatment are especially adapted to those who look at the subject from a practical standpoint. A noticeable defect in the book is the absence of accurate data. The reader is simply told that one fungicide gave better results than another, or that much or little was saved by its use. A few data as to the weight of the fruit and condition of the vines would add much to the value of these statements. Two fungicides are recommended as best adapted for preventing mildew—Bordeaux mixture and another mixture in which soda is used instead of lime. Accurate estimates as to the cost of the fungicides, and directions for their preparation are given. Some important questions in regard to the latter point were referred to a German chemist, and a few points in his report are worthy of special mention. He advises that the mixtures should always be prepared cold, and that in order to obtain the precipitate in the most finely powdered condition, the more concentrated solution should be poured into the dilute one. He further advises that the copper solution be the concentrated one in both mixtures.—E. A. SOUTHWORTH.

INDEX TO NORTH AMERICAN MYCOLOGICAL LITERATURE.

By DAVID G. FAIRCHILD.

243. ANDERSON, F. W. **A new Fomes from northern Montana** (with plate XII). Bot. Gaz., April 18, 1891, p. 113. Describes *Fomes Ellisianus* on *Shepherdia argentea*.

244. ARMSTRONG, L. H. **Smut and rust fungus.** Florida Dispatch, Farmer and Fruit-Grower, Jacksonville, Fla., May 28, 1891, No. 1165, vol. III, No. 22, p. 429 (2 columns). Gives extracts with comments from bulletins of Kansas Ex. Station in regard to prevention of smut in cereals. (See Nos. 156, 157, 212.)

245. ARTHUR, J. C. **Loose smut of oats.** Bull. 35, vol. II, March 30, 1891, Purdue University, Lafayette, Ind. Ag. Ex. Sta., pp. 81-107. Discusses abundance of disease, recording on the station farm a loss of 18 per cent and estimating the loss in Indiana in 1889 as equaling \$797,526 and in 1890 \$605,352. Describes the hot-water treatment, giving an experiment with 12 lots of seed dipped in hot water of 7 different degrees of temperature from 120° F. to 150° F., which resulted in a decrease of the amount of smut in every case. The tem-

245. ARTHUR, J. C.—Continued.
perature of the water selected as most advisable in practical treatments is 135° F., with time of immersion of 5 minutes. Shows further that the average height of treated seed when full grown is greater than that of untreated, and records experiments upon effect on vitality of seed treated with hot water, showing that the treatment up to a certain point hastens germination in a very remarkable degree, and also that no injury is sustained by treated seed when treated as long as 277 days before planting. Experiments with copper sulphate show this substance to retard germination and decrease the yield, although preventing the smut.

246. ATKINSON, GEORGE F. **Black rust of cotton.** A preliminary note; Bot. Gaz., vol. XVI, No. 3, pp. 61–65.

246a. ———. **Black Rust of Cotton,** Bull. 27, Agrl. Ex. Sta., Auburn, Ala., May, 1891, pp. 1–16. Attributes disease to attacks of four parasites, *Colletotrichum gossypii*, South., *Macrosporium nigricantium*, Atkinson (with figs.), *Cercospora gossypina*, Cooke, a species of *Alternaria* and a bacterial organism. Gives history and description of the different forms, with notes upon the current theories as to the cause of the rust; the parts most subject to diseases, power of the plant to resist fungous parasites, and prospective outline of experiments.

247. ———. **Some Erysipheæ from Carolina and Alabama** (with plate and figs.). Journal Elisha Mitchell Scientific Society, 1890, 7th year, part II (published 1891), pp. 61–74. Offers results of the study of material collected in North and South Carolina and Alabama as a contribution to the knowledge of the Southern forms. Puts the matter in convenient shape for collectors and students, describing genera and species with hosts plants, as follows: *Sphærotheca castagnei*, Lev.; *S. humuli*, (DC.) Bur.; *Erysiphe communis*, (Wallr.) Fr.; *E. cichoracearum*, DC.; *E. liriodendri*, Schw.; *Uncinula spiralis*, B. & C.; *U. macrospora*, Peck; *U. flexuosa*, Peck; *U. parvula*, C. & P.; *U. polychæta*, (B. & C.) Masse; *Phyllactinia suffulta*, (Rab.) Sacc.; *Podosphæra biuncinata*, C. & P.; *Microsphæra semitosta*, B. & C.; *M. diffusa*, C. & P.; *M. vaccinii*, C. & P.; *M. euphorbiæ*, B. & C.; *M. Van Bruntiana*, Ger., which the author, in contradistinction to Burrill, separates from *M. alni*, (DC.) Winter, on account of the difference in appendages (with figs.), *Microsphæra quercina*, (Schw.) Burrill; *M. calocladophora*, Atkinson (*M. densissima*, E. & M. Jour. Mycology, vol. I, 1885, p. 101.)

248. BESSEY, C. E. **An important work on the fungi.** American Naturalist, February, 1881, vol. XXV, No. 290, p. 150. Mentions Ellis & Everhart's new work on Pyrenomycetes. (See No. 193.)

249. BJERGAARD, J. PEDERSEN. **Prevention of rust in cereals.** American Agriculturist, March, 1891, vol. L, No. 3, p. 136. Discusses various methods of treatment with hot water for the prevention of *Puccinia graminis*. Describes it to be prevented by immersing the seed grain for a certain time in warm water of a certain temperature, followed by rapid cooling in cold water. Gives the following instructions: For prevention of rust in barley: "Immerse the seed barley perfectly in cold water for 4 hours; let it stand in wet bags in a cool, not too drying place for at least 4 hours more before the dipping in warm water is to be performed." Finds 123° F. to be sufficiently high temperature for the water to immerse seed grain in. Describes method of dipping as in case of smut of cereals. Concludes for oats, wheat, and rye, the grain may be dipped without previous soaking and that the temperature of the water for oats and wheat must be 133° F., to begin with, and 129° F. at end. Reports temperature of 126° as proving preventive of the rust. Discusses forms of hampers for containing seed. Refers to work of Jensen.

250. BOLLEY, H. L. **Grain smuts** (with figs.). Bull. No. 1, Agrl. Ex. Station, Fargo, N. Dak., June, 1891. Brings together work of Arthur, Kellerman and Swingle, Jensen, and others upon the subject, using figures from various authors, together with original. Adds much of popular nature to express results obtained by various investigators.

251. BUTZ, GEORGE C. **Black knot on plums (with plates).** Bull. 13, Penn. State Ag. Ex. Sta., October, 1890, p. 34. Instructs orchardists how to eradicate disease by usual methods of pruning.

252. CLARK, JOHN W. **Spraying for codling moth and apple scab [*Fusicladium dendriticum*, (Wall.) Fckl.].** Bull. 13, Miss. Ag. Ex. Sta., January, 1891, p. 6. Reports good results from use of Bordeaux mixture in treatment of disease.

253. ———. **Black rot of the grape [*Læstadia Bidwellii* (Ell.) V. & R.]** *Ibid.* Gives inconspicuous results from use of Bordeaux mixture in treatment of the disease.

254. ———. **Experiments with the Bordeaux mixture upon the grape rot [*Læstadia Bidwellii*, (Ell.) V. & R.].** Bull. 10, Ag. Ex. Sta., Columbia, Mo., April, 1890, p. 5. Reports saving of 75 per cent of grape crop by spraying with Bordeaux mixture after rot had appeared.

255. COOKE, M. C. **Additions to Merulius.** Grevillea, June, 1891, vol. XIX No. 92, p. 108. Describes *Merulius rimosus*, Berk., in Herb. on Alder from New York, collected by J. B. Ellis, No. 586.

256. DIETEL, P. **Bemerkungen über die auf Saxifragaceen vorkommenden Puccinisarten.** Berichte der Deutschen Botanischen Gesellschaft IX. März 23, 1891, pp. 35–45, Taf. III. Gives comparison of species of Puccinia on the *Saxifragaceæ*, with numerous references to the North American species, which he decides referable to *P. saxifragæ*, Schlect. (*P. curtipes*, Howe); *P. adoxæ*, DC. (*P. pallido-maculata*, E. & E.); *P. heucheræ*, (Schw.). Thinks *P. striata*, Cke., No. 1465 N. A. F., incorrectly determined, while *P. spreta*, Pk. and *P. tiarellæ*, Pk. are probably identical with *P. heucheræ*, (Schw.) and only slightly different from *P. congregata*, Ell. & Hark.

257. ELLIS, J. B., AND ANDERSON, F. W. **New species of Montana fungi** (with figs. and plate). Bot. Gaz., vol. XVI, No. 2, February 15, 1891, pp. 45–49. Describe *Lentinus pholiotoides*, *Helotium Montaniense*, *Volutella occidentalis*, *Sporidesmium sorisporioides*, *Macrosporium puccinioides*, *Æcidium liatridis*, *Æcidum cleomis*, *Æcidium chrysopsidis*, *Pestalozziella Andersoni* Ell. & Everh., as occurring in Montana; and (out of place according to title), *Phoma ilicina* and *Coniothyrium ilicinum* upon *Ilex*, and *Dothiorella nelumbii* on receptacle of *Nelumbium*; from Washington, D. C.

258. ——— AND EVERHART, B. M. **Note sur un Coprir sclératoide observé à Montana** (with plate). Revue Mycologique, 13 a'n. Jan. 1891, No. 49, pp. 18–20. Traduit par M. O. Debeaux du texte Anglaise. Describes *Coprinus sclerotigenus*, n. s. from Montana arising from a sclerotium, although resembling somewhat *C. tuberosus*, Quelet, found in France (see No. 38).

259. FAIRCHILD, D. G. **A few common orchard diseases.** Fancier and Farm Herald, Denver, Colo. Gives popular exposition of more common diseases, with well-known remedies for treatment of same.

260. ———. **Diseases of the grape in western New York.** Paper read before the annual meeting of the Western New York Horticultural Society, Rochester, January 28–29, 1891. Proc. 36th Ann. Meeting of Western New York Hort. Soc., p. 76. Same in Garden and Forest, vol. IV, No. 154, February 4, 1891, p. 59. Cultivator and Country Gentleman, Feb. 26, 1891, vol. LVI, No. 1987, p. 169. The Vineyardist, Penn Yan, N. Y., April 1 and 15, 1891, vol. III, Nos. 71 and 72, pp. 490, 497. Vick's Illustrated Monthly Magazine, Rochester, N. Y., vol. 14, No. 3, March, 1891, pp. 98–112. Discusses in a more or less popular way the diseases caused by *Peronospora viticola*, (B. & C.) DBy.; *Uncinula spiralis*, B. & C.; *Læstadia Bidwellii*, (Ell.) V. & R.; *Glæosporium fructigenum*, Berk.; and *Sphaceloma ampelinum*, DBy. Gives method of treatment of various diseases, and a note upon a new disease in the region similar to the French malady of *Rougeot*.

261. FLETCHER, JAMES. **Black knot of the grape.** Appendix to Report of Minister of Canadian Agricultural Experimental Farm, Ontario, Canada for 1889 (1890):

261. FLETCHER, JAMES—Continued.
Report of Entomologist, p. 87. Notes occurrence near Port Hope, Ontario, of a peculiar cracking of the bark of the grape canes, known among Germans as "Krebs" or "Schorf," and attributed to freezing of the canes.

262. GALLOWAY, B. T. **Report of the Chief of the Division of Vegetable Pathology, in Ann. Report for 1890, U. S. Dept. of Agriculture** (issued 1891). Treatment of black rot of the grape (see No. 196): Gives results of experiments in Virginia, as described in Journal, vol. VI, No. 3, pp. 89–95. Treatment of pear, cherry, and strawberry leaf-blight as affecting nursery stock: Reports successful prevention of pear leaf-blight by applications of Bordeaux mixture. Finds cherry leaf-blight prevented by either ammoniacal solution of copper carbonate or Bordeaux mixture. Reports successful use of ammoniacal solution in preventing strawberry leaf-blight, giving figures of cost of treatment. Treatment of pear leaf-blight and scab in the orchard: Gives results of comparative test of Bordeaux mixture, ammoniacal solution of copper carbonate, copper acetate (verdigris), and copper carbonate in suspension, with expense of various treatments. Places fungicides as above in order of effectiveness, and finds three early sprayings equally as effective as six continued through the season. Experiments in the treatment of apple scab: Concludes that scab can not be wholly prevented in an unfavorable season by use of ammoniacal solution, Bean's sulphur powder, Mixture No. 5 (equal parts of ammoniated copper sulphate and carbonate of soda), or copper carbonate suspended in water. Finds Mixture No. 5 most effective; early treatment before the opening of the flowers extremely important, and midsummer sprayings of doubtful value. Raspberry leaf-blight: Discloses the fact that raspberry foliage is too delicate to withstand action of Bordeaux mixture or Mixture No. 5; that blackberry foliage, while more resistant than raspberry, is more susceptible than apple. Experiments in the treatment of potato rot: Reports increase in yield of treated over untreated of 25 to 50 per cent. Some practical results of the treatment of plant diseases: Gives figures of expence of treatments made by practical growers. Fungicides and spraying apparatus: Discusses various new fungicides and apparatus. Peach yellows investigation: Gives brief summary of work of Dr. E. F. Smith upon the subject. The California vine disease: Reviews in brief the work of N. B. Pierce, both in the United States and Europe, upon this disease, announcing no definite results. Hollyhock anthracnose [*Colletotrichum malvarum*, (A. Br., & Casp.) Southworth], with colored plate: Gives short statement of the disease affecting greenhouse hollyhocks. Anthracnose of cotton (*Colletotrichum gossypii*, South), with colored plate: Gives brief account of the disease. Ripe rot of grapes and apples (*Glœosporium fructigenum*, Berk.), with colored plate: Short account of the disease described at length in the Journal, vol. VI, No. 4, pp. 164–173.

263. GOFF, E. S. **Bordeaux mixture as a preventive of potato rot.** Rural New Yorker, June 13, 1891, vol. L, No. 2159, p. 453. Gives abstract of report to be published by the Division of Vegetable Pathology upon successful use of Bordeaux as preventive of potato blight. The disease is thought to be different from that caused by *Phytophthora infestans*, DBy, and to resemble the bacterial disease mentioned by Burrill (see No. 188).

264. HALSTED, B. D. **Black rot of the sweet potato** (with fig.). Pop. Gardening, April, 1890, vol. 6, No. 7, p. 128. Gives popular description of *Ceratocystis fimbriata*, Ell. & Hals.

265. ———. **The hydrangea blight.** Garden and Forest, New York, vol. IV, No. 164, April 15, 1891, p. 177 (½ column). Notes serious abundance of *Phyllosticta hydrangeœ*, E. & E., in New Jersey. Recommends ammoniacal solution of copper carbonate as preventive.

266. HALSTED, B. D. **Mildew of sweet alyssum and radish.** *Ibid.*, vol. IV, No. 165, April 22, 1891, p. 189 (½ column). Notices presence of *Peronospora parasitica* on sweet alyssum spread from radishes in greenhouse.

267. ———. **Decay spots upon leaves.** Garden and Forest, vol. IV, No. 166, p. 201, April 29, 1891. Remarks *Botrytis vulgaris* previously nourished on blossoms as cause of decayed patches upon many greenhouse plants.

268. ———. **An abundant rust.** *Ibid.*, No. 171, vol. IV, June. 3, 1891, p. 262. Notices abundance of *Cæoma nitens*, Schw. in 1891.

269. ———. **The forest in one of its relations to the orchard.** Forest Leaves, Philadelphia, March, 1891, vol. III, No. 5, pp. 68–70. Notes presence of black knot (*Plowrightia morbosa*) upon various wild species of *Prunus* and of *Gymnosporangium* upon wild *Juniperus*, recommending the destruction of wild species to protect the orchard trees.

270. ———. **Destroy the black knot of plum and cherry trees** (with figs.). An appeal. Bull., 78 Ag. Ex. Sta., New Brunswick, N. J., pp. 1–14. Describes disease popularly, with instruction of how it may be prevented and an appeal for coöperation in its eradication.

271. ———. **Smut fungi** (with figs. from No. 53). Cultivator and Country Gentleman, Albany, N. Y., June 18, 1891, vol. LVI, No. 2003, p. 491 (2 columns). Gives popular account of different forms of wheat, oat, and corn smut, and conclusions reached by Brefeld delivered in lecture before Agricultural Society of Berlin and translated in Journal of Mycology for 1890. Brings out the main conclusions of the author in a popular way.

272. ———. **The black knot of plum and cherry trees** (with figs.). American Agriculturist, vol. L, No. 5, May, 1891, p. 281. Gives popular description of disease with recommendation to cut out and destroy all infected portions.

273. ———. **The soft rot of the sweet potato** (with figs.). American Agriculturist, March 1891, vol. L, No. 3, p. 146 (2 columns). Gives popular account of trouble caused by *Rhizopus nigricans*, Ehr., with recommendation for careful handling and digging to avoid spread of the fungus. Recommends storing in warm room until all "sweating" is over.

274. ———. **The theory of fungicidal action.** American Agriculturist, New York, June 1891, vol. L, No. 6, p. 323 (1 column). Discusses philosophy of fungicides in popular language. Claims action to be twofold, first by killing fungous spores at forming, and second by killing them as they germinate upon the leaf.

275. HUMPHREY, J. E. **Notes on technique. II.** Bot. Gaz. vol. XVI, No. 3, March 16, 1891, pp. 71–73. Gives account of successful use of 1 per cent solution of osmic acid in killing zoöspores preparatory to staining with alcoholic solution of Hanstein's rosanilin-violet. Finds cilia even in zoöspores of *Achyla polyandra* readily stained by the method.

276. ———. **The black knot of the plum** [*Plowrightia morbosa*, (Schw.) Sacc.] (with plate). Eighth Ann. Rep. of Mass. State Ag. Ex. Station, Amherst, Mass., 1890. Issued January 9, 1891. Gives report on laboratory investigations now in progress, with carefully prepared history of the disease. Reports the malady as strictly American and first described as of fungous origin by de Schweinitz in 1831. Finds the disease distributed throughout the United States, but rare in Texas. From sowing of ascospores in agar the author has succeeded in bringing to maturity the true pycnidial form which had not previously been described. So far as the investigations have gone the author is able to connect positively only three forms, with the black knot the ascospores, the pycnidial form, differing from the pycnidial stage described by Dr. Farlow, and the summer or conidial stage. Decides the stylosporus form described by Farlow as not connected with *Plowrightia morbosa*, and fails to find the presence of the spermogonial stage of this author, but

276. HUMPHREY, J. E.—Continued.
observes in a few cases small spore fruits which may be identical with Dr. Farlow's pycnidia.

277. ———. **The cucumber mildew** [*Plasmopara Cubensis*, (B. & C.)], (with plate). *Ibid.*, pp. 210–212. With history of disease. Gives account of distribution and comparison with the only other known *Peronospora* upon *Cucurbitaceæ* in the United States, *Plasmopara Australis*, (Speg) Swing. Decides both species upon the wild star cucumber (*Sicyos*) and cultivated cucumber are *Plasmoparæ*.

278. ———. **The brown rot of stone fruits.** (*Monilia fructigena*, Pers.) *Ibid.*, pp. 213–216. Reports upon laboratory investigations with the fungus, showing that mummified specimens of plums are able to carry over winter the power of reproducing abundant conidia. From cultures in agar concludes *Monilia fructigena*, Pers., as probably an autonomous fungus and likely to be readily eradicated from orchards by clean culture. Recommends concerted action in removal of infected fruits.

279. ———. **Potato scab.** *Ibid.*, pp. 216–220. Discusses work of other investigators upon the disease, expressing the opinion that the "deep" and "surface" scab are probably not specifically distinct. Thinks the invariable connection of the scab with a parasitic fungus has not been proved. Finds the conditions which least favor the appearance of the disease afforded by *light, open, thoroughly drained soil.*

280. ———. **Damping off** (with figs.). *Ibid.*, pp. 220–221. Identifies cause of disease with presence of *Pythium de Baryanum*, Hesse, and recommends prompt burning of affected plants and removal of infested soil.

281. ———. **The mildew of spinach** [*Peronospora effusa*, (Grev.) Rabh.]. *Ibid.* Notes disastrous presence of fungus in Massachusetts on an allied plant, *Chenopodium album*.

282. ———. **The grape-vine mildew** [*Plasmopara viticola* (B. & C.), Berl. & de Toni]. *Ibid.*, p. 222. Notes occurrence of the species upon *Ampelopsis veitchii* last October at Amherst, Mass.

283. ———. **Potato rot** [*Phytophthora infestans*, (Mont.) DBy.]. *Ibid.*, p. 223. Notes abundance in Massachusetts.

284. ———. **The elder rust.** (*Æcidium sambuci*, Schw.). *Ibid.*, p. 223. Notes destructive abundance on cultivated varieties of *Sambucus*.

285. ———. **The rust of blackberries and raspberries** (*Cæoma nitens*, Schw.). Describes the disease popularly.

286. ———. **The hollyhock rust** (*Puccinia malvacearum*, Mont.). *Ibid.*, pp. 224–225. Gives history of the spread of the disease introduced first from Chili.

287. ———. **Disease of oats.** *Ibid.*, p. 225. Notes occurrence in Massachusetts of a disease of oats not caused by *Uredineæ*, and connected more or less closely with bacteria. Refers to work of Division of Vegetable Pathology upon a similar disease (see THIS JOURNAL, vol. VI, No. 2, p. 72).

288. KELLERMAN, W. A. **Note on the distribution and ravages of the hackberry branch knot** (with plates). Twenty-third Ann. Meeting Kansas Academy of Science, Vol. XII, 1890 (1891), pp. 101–104. Gives counties of State from which the disease has been reported. Thinks it extends west to the limit of forest vegetation (see No. 62).

289. ———. **Jensen's recent experiments.** The Industrialist, Manhattan, Kans., vol. XVI, No. 35, May 23, 1891 (2 columns). Quotes at length from a letter by J. L. Jensen, of Denmark, giving results of treatment in 1890 of seed wheat and oats for smut. Jensen finds the hot-water method and Kuhn's method the only fully satisfactory ones. Quotes Jensen as concluding for four varieties treated that "there was gained by the hot-water method 1 per cent in replacing smutted heads with sound ones, but 8⅜ per cent as an extra benefit; perhaps mainly due to the prevention of "invisible smut." Notes

289. KELLERMAN, W. A.—Continued.
difference in treatment between Jensen and Kellerman & Swingle, consisting in difference in time of immersion in hot water.

290. ——— AND SWINGLE, W. T. **Notes on sorghum smut (with plate).** Report 23d Ann. Meeting Kansas Academy of Science, vol. XII, 1890, extract (1891), p. 158. Give brief account of *Ustilago sorghi*, (Link ?) Passerini and *Ustilago Reiliana*, Kühn, which latter is reported for the first time in the United States.

291. ———. **Additional experiments and observations on oat smut, made in 1890.** Bull. No. 15, Dec., 1890, Agr'l Ex. Sta., Manhattan, Kans. (Issued March 20, 1891.) Continue work of previous year upon the subject, giving results of extended experiments in the prevention of the disease, including the test of 155 treatments of seed previous to planting. Give numerous observations as to the amount of smut, concluding from a careful estimate that there was in the State of Kansas a loss in 1890 of between 6 and 7 per cent through smut. Report superiority of Jensen hot-water treatment over all others for the prevention of the disease, requiring 15 minutes' immersion in water at 132½° F., but recommend, tentatively, use of potassium sulphide one-half per cent solution, in which seed may be immersed 24 hours. Find various other chemicals while preventing the smut greatly injure the stand. Announce the discovery for the first time of a "hidden smut," which, while not apparent without tearing away the glumes, destroys the grain completely. Conclude seed from clean field will produce a crop free from smut, but if adjoining fields are smutty the oats from a clean field will in a few years become infected with the disease.

292. MAGNUS, P. **Ueber das Auftreten eines Uromyces auf Glycyrrhiza in der alten und in der neuen Welt.** (mit Tafel XX). Berichte der deutschen botanischen Gesellschaft. Band VIII, Heft 10, pp. 377–384, December 30, 1890. Discusses at some length the synonymy of the various species of *Uredineæ* described on *Glycyrrhiza* giving history of each description. Concludes the American species found upon *Glycyrrhiza lepidota* by various authors and variously named, to be identical with that upon *Glycyrrhiza glabra*, L., of the East. Draws the conclusion from the fact that the variation of the species of Glycyrrhiza has become specific and the parasite remained the same; that *Uromyces glycyrrhizæ* was parasitic upon plants of the genus Glycyrrhiza before the separation of North America and Europe in the Tertiary period. "Ich glaube daher nicht zu viel zu behaupten wenn ich sage, dass *Uromyces glycyrrhizæ* ein Parasit ist, den Glycyrrhiza seit den Zeiten bewohnt, da Nordamerika und Europa noch ein einheitliches Florengebiet bildeten." Gives preference to name *Uromyces glycyrrhizæ*, (Rabh.) Magnus, with the following synonymy: *Puccinia glycyrrhizæ*, Rabh., in Klotzsch, Herb. mycologicum, No. 1396. *Uredo leguminosarum*, (Lk.) form *glycyrrhizæ*, Rabh., in Flora, 1850, p. 626. *Uromyces appendiculata*, (Pers.) Rabh., in Isis, 1870, Heft IV, No. 18. *Cæoma* (*Uredo*) *glumarum*, (Desm.) Sorokin, in Materialien sur Flora Mittelasiens (Bull. der Naturforschenden Gesellschaft in Moskau, 1884. *Uromyces trifolii*, (Alb. und Schwein.) Wint., in Ell. & Everhart, N. A. F., 187–. *Uromyces genistæ-tinctoriæ*, (Pers.) Wint., 1887, in Acta Horti. Petoprolitani. vol. X, p. 262.

293. MASSEY, W. F. **Clover and cotton rust.** American Agriculturist, March, 1891, vol. L, No. 3, p. 144, (½ column). Upholds as plausible the theory of practical farmers that cotton rust spreads from clover fields lying adjacent to cotton fields.

294. MAYNARD, S. T. **Fungous pests.** Bull. 13, Mass. Hatch. Ex. Sta., April, 1891, pp. 3–10. Gives names of various fungi causing diseases of orchard, with formulæ for fungicides and outline of treatment of the same.

295. MCCARTHY, GERALD. **Copper salts a possible source of danger.** Agricultural Science, vol. V, No. 6, June, 1891, La Fayette, Ind., pp. 156–158. Gives summary of results of the German scientist, Dr. Haselhoff, read in a paper before

295. McCarthy, Gerald—Continued.
the German Association at Bremen, showing the poisonous effects of copper sulphate. The investigator finds the dry substance of plants grown in soil impregnated with copper sulphate to decrease in proportion to the quantity of that salt present. Expresses the opinion that the formulæ for the Bordeaux mixture may be modified, greatly lessening the amount of copper, and refers to work done at St. Michel Experiment Station and to experiments performed by Quantin, Mason, and others. Reports Bordeaux mixture containing one-fourth to one-eighth the usual amount of copper as giving results equivalent to the regular formula.

296. Morgan, A. P. **North American fungi.** Fourth paper. Read January 6, 1891 (with plates). The Gastromycetes. The Journal of the Cincinnati Society of Natural History, Cincinnati, Ohio, vol. xiv, No. 1, Apr., 1891, pp. 5–21 (a continuation from vol. xii, p. 172, of same journal). Treats of the North American species of *Lycoperdon*, Tourn., giving generic and specific descriptions, with notes upon distribution. Describes as new *L. Peckii*, Morg.; *L. elegans*, Morg.; *L. muscorum*, Morg., and gives careful descriptions of 28 other species with frequent figures. Monographic and of great value to mycologists in the study of this genus.

297. Moseley, Henry C. **The chinch bug cholera.** Farmers' Review, Chicago, Ill., June 3, 1891, vol. xxii, No. 22, p. 255 (1 column). Notes appearance in Illinois of a mold upon chinch bugs and refers to work of Professor Snow on the subject (see 103).

298. Phillips, W. **Omitted Discomycetes.** Grevillea, June, vol. xix, No. 92, p. 106. Describes *Helotium aurantiacum*, Cke., on underside of decayed leaves. U. S., J. B. Ellis, No. 75. *Lachnella albopileata*, Cke., var. *subaurata*, Ellis, on both sides of leaves of *Clethra alnifolia*, from J. B. Ellis, Newfield, N. J., U. S.

299. Pearson, A. W. **Experiments in treatment of the diseases of plants.** Gard. and Forest, New York, vol. iv, No. 154, Feb. 4, 1891, p. 52. Gives, in brief, results of experiments with copper mixtures. Concludes copper acetate (2¼ pounds in 25 gallons of water) as good as Bordeaux mixture for potato blight; iron sulphate ineffectual in treatment of grape diseases. Gives the formula for the mixture of copper carbonate and glue as effective against vine diseases (1 pound copper carbonate, 3 ounces glue, 25 gallons water). Reports failure to control Anthracnose with the copper mixtures.

300. Prentiss, A. N. **History of the current progress of the economic study of plant diseases.** Proc. Western New York Hort. Soc., 36th Ann. Meeting, January 28–29, 1891, Rochester, N. Y., pp. 18–21. Garden and Forest, February 11, 1891, vol. iv, No. 155, p. 71. Outlines history of the study in this country, mentioning the work of Engelmann, Farlow, Burrill, Peck, Arthur, and others, calling attention to the work of the Department of Agriculture and of the Experiment Stations.

301. Scribner, F. L. **Fungous diseases of the grape and other plants** (with numerous figures). 12mo, 134 pp., J. T. Lovett & Co., Little Silver, N. J., 1890 (issued in 1891). The author describes in clear, popular style the various diseases of plants. Gives special attention (92 pages) to the diseases of the grape. The work is especially adapted for the use of vineyardists and fruit-growers and fills a want which is rapidly growing. After a short introductory of what fungi are, the second and third chapters are devoted to black rot of grapes and its treatment. The general characteristics of the malady followed by a description of the parasitic fungus are given, together with an account of experiments made in its treatment. Chapter iv describes bitter rot (*Greeneria fuliginea*) and white rot (*Coniothyrium diplodiella*), with suggestions for treatment as in black rot. Chapter v treats of brown rot (*Peronospora viticola*). Chapter vi, powdery mildew (*Uncinula ampelopsidis*).

301. Scribner, F. L.—Continued.
Chapter vii, grape leaf blight (*Cladosporium viticolum*). Chapter viii, root rot of the vine (*Agaricus melleus* and *Dematophora necatrix*), with figures from Millardet, Hartig, and Viala. Recommends immediate removal of attacked vines, thorough drainage and cleaning of ground of all vegetation for several years, and trenching about affected area for prevention of spread of disease. Chapter ix, Anthracnose and birds'-eye rot (*Sphaceloma ampelinum*). Recommends early washing of canes with 50 per cent solution of iron sulphate or 10 per cent solution of copper sulphate and dusting of vines with sulphur and powdered lime if disease appears during the growing season. Chapter x, dotted or speckled Anthracnose of the vine. Chapter xi, black rot of the apple (*Macrophoma malorum*). Chapter xii, apple rust and cedar apples (*Gymnosporangium macropus*). Recommends removal of cedar trees near orchard, planting of resistant varieties, and spraying with Bordeaux as soon as leaves start. Chapter xiii, apple scab (*Fusicladium dendriticum*). Gives course of treatment, recommending early spring washing with simple solution of copper sulphate (1 pound to 10 gallons of water), together with three early sprayings with the ammoniacal solution or modified eau céleste. Chapter xiv, pear scab (*Fusicladium dendriticum*). Considered by the author as only a form of this species and not specifically distinct. Chapter xv, the Entomosporium of the pear and quince (*Entomosporium maculatum*). Recommends winter treatment with copper sulphate and treatments during the growing season with Bordeaux mixture. Chapter xvi, plum rot or the Monilia of fruit (*Monilia fructigena*). Recommends clean culture and a trial of the ammoniacal solution of copper carbonate as preventive. Chapter xvii, black knot of the plum and cherry. Recommends usual method of removal of infected parts and disinfection with Bordeaux mixture. Thinks disease a fit subject for legislation. Chapter xviii, leaf-spot disease of the plum and cherry (*Septoria cerasina*). Chapter xix, powdery mildew of the cherry (*Podosphæra oxyacanthæ*). Recommends use of flowers of sulphur and potassium sulphide (½ ounce per gallon of water). Chapter xx, peach leaf curl (*Taphrina deformans*). Chapter xxi, the fungus of the raspberry Anthracnose. Recommends winter wash for canes 50 per cent solution of iron sulphate and applications of sulphur and powdered lime in equal parts.

302. ———. **Powders for combating the fungous or cryptogamic diseases of plants.** Rural New Yorker, June 13, 1891, vol. l, No. 2159, p. 453. Discusses various powders used as fungicides, recommending two for further trial, viz, sulphatine and sulpho-steatite. Refers to Circular 5 of Division of Vegetable Pathology, U. S. Dept. of Agr.

303. ———. **Leaf-spot of the India-rubber tree** (*Leptostromella elastica*, Ellis & Scribner) with figs. Orchard and Garden, Little Silver, N. J., January, 1891, vol. xiii, No. 1, p. 6. Ascribes cause of the disease of *Ficus elastica* to a new species of *Leptostromella* described by Ellis & Scribner.

304. ———. **Leaf-spot of screw palm** (*Physalospora pandani*, Ellis & Scribner) with figs. Orchard and Garden, Little Silver, N. J., January, 1891, vol. xiii, No. 1, p. 6. Describes the disease common upon leaves of screw palm found at Knoxville, Tenn., as caused by a new species of *Physalospora* described elsewhere.

305. ———. **Plum leaf of shot-hole fungus** (with figs.). Canadian Horticulturist, Grimsby, Ontario, November, 1890, vol. xiii, No. 11, pp. 315–316. Reproduction of article in Orchard and Garden, giving short account of the disease.

306. ———. **Black knot of the plum and cherry** (with plate). Bull. Tenn. Agr. Ex. Sta., vol. iv, No. 1, January, 1891, pp. 26–28, Knoxville, Tenn. Describes disease and shows necessity of concerted action in stamping out the parasite.

307. Smith, Erwin F. **Peach yellows.** Synopsis of an address at Easton, Md., January 22, 1891. Reprint from Proceedings of Peninsula Hort. Soc., p. 8.

)7. SMITH, ERWIN F.—Continued.
Gives figures showing great increase of the disease in ten representative orchards in the upper part of Delaware and Chesapeake peninsula from 1887 to 1890. Reports results of inoculation experiments by budding healthy trees with diseased buds, showing the contagious nature of the malady. (These results are to be published in Bulletin No. 1 of the Division.) Answers numerous inquiries in regard to the eradication of the disease, deciding that concerted action in the matter of removal of diseased material is the best means known for the prevention of spread of the malady. States that fertilizers have been of no advantage whatever in experiments of the past three years.

08. SOUTHWORTH, EFFIE A. **A new hollyhock disease** (with fig. copied). Popular Gardening, December, 1890, vol. VI, No. 3, pp. 56-57. Reprint of figures and abstract of article in Journal of Mycology, vol. VI, No. 3.

)09. SWINGLE, W. T. **First addition to the list of Kansas Peronosporaceæ.** Extract from Trans. 22d and 23d Ann. Meetings, Kansas Acad. Sci., vol. XII, Topeka, Kans., pp. 129-134 (March 30, 1891). Gives corrections and additions to original list (see THIS JOURNAL, vol. 6, No. 1, p. 41), reporting *Acnida tuberculata* as new host in the State for *Cystopus amaranti*, (S.) Berkeley, *Bidens chrysanthemoides*, Mich. as new host for *Plasmopara Halstedii*, (Farlow) Berlese and De Toni., and *Peronospora calotheca*, DBy. as a species new to the State, growing on *Galium aparine*. Notes ability of *Peronospora euphorbiæ* to withstand drought and habit of *Peronosporaceæ* in general to confine their attacks in dry weather to their commoner host plants. Reports from State, including this additional list, 33 species on 71 different hosts.

310. THAXTER, ROLAND. **The Connecticut species of Gymnosporangium** (Cedar Apples). Bull. No. 107, Conn. Ag. Exp. Sta., New Haven, Conn. (Distributed April 15, 1891.) Reports seven distinct species for the State, two upon *Cupressus thyoides*, one on *Juniperus communis*, three upon *J. Virginiana*, and one upon both *J. communis* and *J. Virginiana*. Records successful establishment of connection of *Gymnosporangium* with its proper rust in all cases but that of *G. Ellisii*, and describes as new species discovered by cultures *Gymnosporangium nidus-avis*, Thaxter on *Juniperus Virginiana*, with *Rœstelia* stage upon *Cydonia* (quince) and *Amelanchier Canadensis*.

311. ———. **The potato scab** (with plate). Report of Mycologist in 14th Ann. Rep. Conn. Ag. Ex. Sta., 1890 (1891), pp. 3-17. Discusses fully the various theories proposed to account for the disease, deciding Brunchorst's *Skurv* as specially distinct from American scab. Gives general characteristics of the disease, with account of the invariable presence when properly examined of an extremely minute fungus, resembling, with exception of its true branching fructification, some of the polymorphic bacteria. Records the entirely successful cultivation of the fungus upon various media and the life history as far as understood. Describes most striking series of successful inoculations of healthy tubers with pure cultures and with the fungus freshly removed from diseased potatoes. Inclines to the opinion that there are two species of scab, which may explain differences in results obtained by Mr. Bolley and the author (see Nos. 120-121).

312. ———. **Diseases of tomatoes.** *Ibid.*, p. 17. Reports *Phytophthora infestans*, DBy. *Cladosporium fulvum*, Cke., *Macrosporium tomato*, Cke., and *Fusarium lycopersici*, Sacc., as causing damage in the State of Connecticut.

313. ———. **Fungous diseases of tomato worms.** *Ibid.*, p. 18. Notes presence for the first time observed, of species of *Empusa* upon larva of the *Sphingidæ* and the occurrence of *Empusa grylli*, form *aulicæ*, on *Phlegethontius Carolina* and *P. celeus*.

314. ———. **Fungous diseases of grape-leaf hopper and cabbage worms.** *Ibid.*, p. 19. Reports species of *Empusa* upon grape-leaf hoppers (*Tettigonia vitis*) as also liv-

314. THAXTER, ROLAND—Continued.
ing upon the cabbage worm (*Pieris rapæ*). Gives results of simple experiment which showed the identity of the two diseases as being caused by the same species of *Empusa*.

315. ———. **Peronospora on cucumbers.** (*P. Cubensis*, B. & C.) *Ibid.*, p. 19. Reports occurrence at South Manchester, Conn.

316. ———. **Mildew of Lima beans.** *Ibid.*, p. 19. Reports extension of *Phytophthora phaseoli*, Thax., from New Haven to Hartford and west to Norwalk. Does not find it outside of State.

317. ———. **Rust of pears.** *Ibid.*, p. 20. Shows presence of *Ræstelia* stage of *Gymnosporangium globosum* upon pears of the Japanese strain.

318. ———. **Mildew of buckwheat.** *Ibid.*, p. 20. Reports *Ramularia rufo-maculans* on buckwheat.

319. ———. **Rye rust and smut.** (*Puccinia rubigo-vera*, (DC.) Wint, and *Urocystis occulta*, Rabh.) Reports as unusually abundant.

320. ———. **Some results from the application of fungicides.** (Leaf spot of quince, with plate, *Entomosporium maculatum*). *Ibid.*, pp. 21, 22. Reports successful use of Bordeaux mixture and ammoniacal solution of copper carbonate against disease, with preference for the Bordeaux.

321. ———. **Black rot of grapes.** Records success in treatment of disease with Bordeaux and copper carbonate in ammonia.

322. ———. **Leaf spot of plums and cherries causing defoliation.** *Ibid.*, p. 24. Records successful use of Bordeaux mixture in prevention of the disease, trees sprayed holding their leaves intact, while those unsprayed dropped their leaves in July.

323. ———. **Potato blight.** *Ibid.*, p. 24. Reports successful checking of disease by the use of Bordeaux, giving comparison of 3½ bushels per row as compared with 6 bushels sprayed. Only 5 rows were treated.

324. ———. **Strawberry rust.** *Ibid.*, p. 24. Records negative experiment with fungicides in its prevention.

325. ———. **Further experiments on the "smut of onion."** Continues last year's experiments and reports the flowers of sulphur sown with the seed as giving results in the ratio of 5 to 1. In a large experiment finds sulphide of calcium, muriate of potash, muriate of lime, and hyposulphite of sodium of little value, while sulphide of potassium and flowers of sulphur gave moderate results. Finds from greenhouse cultures that the first leaves of seedlings are susceptible to infection by germinating smut spores while being pushed through the ground.

326. ———. **Fungicides and their application** (with fig.). *Ibid.*, pp. 26–35. Discusses methods of application, pumps, hose, nozzles, describing a convenient pump to be used with a copper tank shaped like a washboiler. Gives formulas of Bordeaux, copper carbonate, ammoniacal copper carbonate and ammonia-copper solutions made by mixing copper sulphate and ammonium carbonate together in proportions of ¼ pound of copper sulphate to 1 pound ammonium carbonate.

327. WEED, C. M. **Preventing downy mildew or brown rot of grapes** (with figs.). Bull. Ohio Ag. Ex. Sta., vol. III, No. 10, November, 1890 (issued 1891). Columbus, Ohio. Reports results of experiments in Ohio with these diseases, showing pronounced success with eau celeste and total failure with iron sulphate (copperas). Concludes eau celeste superior as preventive to ammoniacal copper carbonate.

328. WOODWORTH, C. W. **Botanical notes.** Second Ann. Rept. Ark. Ag. Ex. Sta., 1889 (published 1890), pp. 191–193. Describes in a popular way, giving remedies, pear blight, grape mildew, black rot of the grape, and sorghum blight. Claims to have discovered *Bacillus sorghi*, Burrill, while studying under Professor Burrill. Gives formulas for fungicides.

YEOMANS, W. H. Bean rust and other fungous diseases. Popular Gardening, November, 1890, vol. 6, No. 2, p. 27 (½ column). Popular description of diseases.

ZABRISKIE, J. L. The fungus Pestalozzia insidens, n. s. (with plate). Journal N. Y. Mic. Soc., July, 1891, vol. VII, No. 3, pp. 101–102. Describes the species as new on bark of living trees of *Ulmus Americana*. Collected near Baltimore, Md.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF VEGETABLE PATHOLOGY.

Vol. VII. No. 2.

THE JOURNAL OF MYCOLOGY:

DEVOTED ESPECIALLY TO THE STUDY OF FUNGI IN THEIR RELATION TO PLANT DISEASES.

EDITED BY

THE CHIEF OF DIVISION AND HIS ASSISTANTS.

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DIVISION OF VEGETABLE PATHOLOGY.

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PUBLICATIONS OF THE DIVISION OF VEGETABLE PATHOLOGY.

The Division of Vegetable Pathology, formerly a section of the Botanical Division, has become a separate organization by act of Congress. Its bulletins will henceforth be numbered independently and in a new series; but the following list contains all publications issued since its organization as a Section, together with Bulletin 1 of the new series.

Bulletins and circulars still on hand for distribution are designated by an asterisk (*). Bulletins 1, 3, 4, and 6, omitted from the list, are publications of the Division of Botany, not relating to vegetable pathology.

JOURNALS.

Journal of Mycology, Vol. V, Nos. 1, 2, 3, and 4. 1889-'90, pp. 249, pl. 14. Vol. VI, Nos. 1, 2, 3, and 4.* 1890-'91, pp. 207, pl. 18. Vol. VII, No. 1,* 1891, pp. 68, pl. 10.

BULLETINS.

No. 2. Fungous Diseases of the Grape. 1886, pp. 136, pl. 7.
No. 5. Report on the Experiments made in 1887 in the Treatment of Downy Mildew and Black Rot of the Grape. 1888, pp. 113.
No. 7.* Black Rot. 1888, pp. 29, pl. 1.
No. 8.* A Record of Some of the Work of the Division. 1889, pp. 69.
No. 9. Peach Yellows. 1889, pp. 254, pl. 36.
No. 10. Report on the Experiments made in 1888 in the Treatment of Downy Mildew and Black Rot of the Grape, pp. 61.
No. 11. Report on the Experiments made in 1889 in the Treatment of Fungous Diseases of Plants. 1890, pp. 119.
Farmers' Bulletin No. 4.* Fungous Diseases of the Grape and their Treatment. 1891, pp. 12.
No. 1.* Additional Evidence on the Communicability of Peach Yellows and Peach Rosette. 1891, pp. 65, pl. 39.
Farmers' Bulletin No. 5*. Treatment of Smuts of Oats and Wheat. 1892, pp. 8, pl. 1.

CIRCULARS.

No. 1. Treatment of Downy Mildew and Black Rot of the Grape. 1885, pp. 2.
No. 2. Grapevine Mildew and Black Rot. 1885, pp. 3.
No. 3.* Treatment of Grape Rot and Mildew. 1886, pp. 2.
No. 4.* Treatment of the Potato and Tomato for Blight and Rot. 1886, pp. 2.
No. 5.* Fungicides or Remedies for Plant Diseases. 1888, pp. 10.
No. 6.* Treatment of Black Rot of the Grape. 1888, pp. 3.
No. 7.* Grapevine Diseases. 1889, pp. 4.
No. 8. Experiments in the Treatment of Pear Leaf Blight and Apple Powdery Mildew. pp. 11.
No. 9.* Root Rot of Cotton. 1889, pp. 4.
No. 10.* Treatment of Nursery Stock for Leaf Blight and Powdery Mildew. pp. 8.
No. 11.* Circular of Inquiry on Grape Diseases and their Treatment. p. 1.
No. 12.* Circular of Inquiry on Rust of Cereals. p. 1.

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ANNOUNCEMENT.

With the present number of the JOURNAL there is a new departure in relation to the Index to Literature. Heretofore it has been confined to American publications, but in this and subsequent numbers the scope will be enlarged to include foreign papers. The arrangement also will hereafter be different; instead of being strictly alphabetical the papers will be arranged according to subjects. This will render it easier to look up any special subject, and it is believed will make the Index more valuable. The papers will be noticed by different members of the divisional force, and initials appended to each review will indicate the responsibility for the notice.

The Index is designed especially to aid Experiment Station workers and others in this country who do not have access to the more important literature on plant diseases and allied subjects. In order to make the Index more valuable, especially as regards accessibility, it is suggested that the various items be cut out, pasted on cards, and then arranged alphabetically according to authors and subjects. For this purpose we use the Library Association's standard cards, No. 32, 5 by 12½ centimeters. By adopting this method, new cards may be inserted at any time, thus making it possible to keep all of one author's writings together, or all that has been written on any one subject. Those desiring to adopt this plan can obtain extra copies of the Index by writing for them.

In order that we may make the Index as complete as possible, it is earnestly requested that authors everywhere forward to the Division of Vegetable Pathology their publications relating to plant diseases as soon as they are issued. These will be kept on file in the divisional library for convenient reference.

A DISEASE OF ALMOND TREES.

By Newton B. Pierce.

(Plates XI—XIV.)

During the early part of August, 1891, while engaged in work on the vine disease of southern California, the writer observed a number of almond trees east of the village of Orange, Orange County, severely affected by a fungus infesting the leaves. This parasite is *Cercospora circumscissa*, Sacc., a form also occurring on *Prunus serotina*, the wild black cherry of the East.

The affected trees observed were large and old, but, according to Mr. Moore, the manager of the place, were unfruitful. The leaves were riddled by the fungus. Several trees had lost most of their foliage, which thickly carpeted the ground. Owing to the perforations of the parasite most of the fallen leaves looked like strainers. It seemed probable that they had fallen earlier than they would had the fungus not been present, but owing to the lack of previous observations I could not then speak positively. The observations of Mr. Ellwood Cooper given below confirm this opinion.

After these observations many others were made throughout the region. Scattered trees were seen in many orchards, and all were more or less affected. Later in August I visted Florence, Los Angeles County, and there observed the same effects, but less seriously developed. In the latter part of the same month I conversed with Mr. L. Thurston, at Santa Ana, in relation to this disease. The Thurston place has one of the most profitable almond groves of Orange County, and is near Arch Beach. At the close of September, Mr. Thurston wrote an account of the disease in his orchard, saying that the leaves remaining on the trees were seriously affected, while those already fallen, comprising most of the foliage, were completely riddled by the parasite. Mr. Ellwood Cooper, State horticultural commissioner, who has large almond interests near Santa Barbara, Cal., writes as follows respecting the disease:

> The disease here has been very bad for several years; I cannot recall its first appearance on my place. I have over 10,000 trees. They generally cast their leaves in June and July. The first appearance of the disease is a yellowish brown spot on the leaf. * * * Very soon the round piece falls out and the leaf falls from the tree. Sometimes there are a number of such spots in each leaf. [This is nearly always true.] It causes the leaves to fall too soon and before the woody portion has been perfected, and hence an insignificant crop the coming year. The blight does not seem to get any worse, but it is bad enough to cause great loss in crops.

It is evident that *Cercospora circumscissa*, Sacc., has developed to a very injurious extent in California, especially in the coast region. The coast counties will always be apt to suffer most from its action because of the frequent fogs and the greater general humidity of the atmosphere. Almond leaves from St. Helena, Suisun, and Acampo, Cal., fail to reveal the presence of *C. circumscissa.* Some "shot hole" fungus, however, is injurious at Suisun.

SOME OF THE STOCKS AFFECTED.

According to Mr. J. B. Ellis, *C. circumscissa* has been found on the peach in Florida by Mr. Calkins. The form affecting the almond and that on the peach, as found in California, are doubtfully distinct. Peach trees grown in close proximity to affected almond stocks may produce fruit considerably marked by this fungus. On one peach many conidia were found. There is evidence that this form does not readily mature spores on the peach, although many points of infection may be present. Thirty-six such points were seen on one stunted peach an inch in diameter. The fungus produces on the fruit a black, circular, depressed spot, which injures its appearance, although the decay does not extend inward more than one-eighth of an inch. All parts may be affected and the spots somewhat resemble those produced on the same fruit by *Cladosporium.* The leaves of peach trees are likewise considerably affected by *Cercospora.* The trees affected are only those situated so near diseased almonds that infection may occur by spores falling or blowing from them. On a portion of one peach tree thus situated the leaves near the almond were nearly destroyed. (Plate XI, Fig. 1.) Peach trees in other portions of the orchard, even those growing within 40 feet of the affected almonds, were virtually free from the disease. Leaves from peach grafts on almond stocks growing at Arch Beach showed the characteristic spots, although the conidia of *Cercospora* could not be found on the material received. These facts indicate that some immediate source of infection extraneous to the peach tree itself must be present before the tree will suffer from the disease. This is explained by the habits of the fungus on peach leaves. While these leaves obtained near affected almond stocks are often thickly infested, a single leaf sometimes showing forty or fifty characteristic points of infection, there are rarely more than two or three of these which bear conidia. They are mostly sterile on both surfaces of the leaf. The parasite penetrates and lives within the peach leaf, producing its usual effects, yet apparently fails to find the proper food supply or other conditions required for reproduction. The fact that the peach tree is usually infected from the almond is opposed to the view that the *Cercospora* found on the former is distinct from that occurring on the latter in California. Peach twigs are in rare instances infested by this fungus.

There is evidence that prune leaves are affected when the prune is grafted to almond stock. Nectarine leaves are also known to be attacked by *Cercospora circumscissa.* Leaves from two-year-old nectarine grafts on diseased almonds grown on the place of Mr. Thurston were infested.

GENERAL AND SPECIAL EFFECTS OF THE FUNGUS.

On the almond tree the effects of this parasite appear on the new and old wood, the leaves, and the nut husks. The most important direct effects are on the leaves. The indirect action of the parasite is due to this injury of the foliage. When the foliage is seriously affected it falls prematurely, leaving the new wood partially ripened or immature. Where soil conditions will admit, a new terminal growth follows the defoliation. This may be compared to the renewal of peach foliage on trees denuded by the "curl-leaf" fungus, *Taphrina deformans,* Tul., though the recovery and reclothing of the almond is less complete. Where the soil conditions are unfavorable and moisture is deficient this secondary growth does not result. On the contrary the immature terminal wood becomes more or less dried and dead. The following season many shoots may be broken with the thumb and finger. As the almond usually sheds its foliage early in the season and before the nuts have fallen, leaving the tree mostly denuded during the latter portion of the summer, any hastening of the defoliation subjects the immature wood to extremes of dryness and heat. In this respect there is a contrast between the situation of the denuded almond tree and that of the peach tree defoliated through the action of the leaf rust, *Puccinia pruni-spinosæ,* P. In the latter case the leaves fall late in the season, after the extremes of drought and heat are moderated and the wood is less apt to become dry. The new foliage of the almond becomes infested like the spring foliage, but it is fresher and healthier than the latter at its fall. This arises largely from the recent pushing of the growth rather than through any diminution in the virulence of the disease.

The trees and earth are covered by millions of spores capable of germinating within a few hours if placed under proper conditions of moisture. The humidity of spring is favorable to germination, while the spores are more numerous in the fall. Infested spots on the twigs are represented on Plate XI, Figs. 2 and 3. Fig. 2 is of natural size and represents new wood, while Fig. 3 is of old wood enlarged 2½ diameters. In the former are shown nine points of infection in a little more than 2 inches. The tissue here involved is sharply defined at the margin; and this is in general characteristic. The circular portion of the cortical tissue often falls out, leaving scars or pits in or through the bark of the twig. In other cases the dead tissue clings to the twig by the center of its inner surface, while the margin has warped outward, giving the piece the form of a watch crystal attached by its convex surface. A rather exceptional case is shown in Fig. 3. This view is sufficiently

large to show the form of the affected disk with its central spore clusters. The fact of special interest here, however, is that the tissue of the branch is altered to a considerable distance from the disk of infection. This is shown by the darkened outer side of the twig. It is the under and more protected portion of the branches which becomes most thickly infested by the parasite. A branch one foot long and three-eighths of an inch in diameter bore twenty points of infection on the upper one-third, while 104 such infections were on the lower two-thirds. This condition is common, and it bears on the application of sprays for prevention. The protection from the heat of the sun on the under surface of limbs gives better conditions for germination and growth and probably accounts for the greater number of infections there.

Transverse sections show that the parasite sometimes kills the tissue of the branch as far inward as the cambium zone and xylem bundles. Figure 4 of Plate XI represents such a section magnified 16 diameters. The cortical parenchyma is mostly affected, but at the center of the affected spot the parasite has destroyed the phloëm and cambium tissues, even penetrating slightly into the xylem rays. The fruiting bodies of the fungus are indicated at the margin of the section near the center of the infested spot. It can not be doubted that twigs infested in this manner at hundreds of places are much injured.

The direct action of *C. circumscissa* on the nut is of little or no importance. It can not penetrate the kernel, and it is only found on the husk, where the characteristic circular spots occur.

The leaf of the almond is the most generally attacked and most seriously affected portion of the tree. In the young and tender leaf, when viewed by transmitted light, the recently infected tissue shows a yellowish spot varying in size according to the state of advancement. This spot presents at this time a dark center. By reflected light the center appears light and the margin dark. Later the sclerotia or tubercular parts of the fungus develop, mostly within the limits of the central area, though not confined to this portion, and when the fascicles of conidia have arisen from them there is a blackish point within the light center. Viewed as an opaque object under a low power these spore clusters are of a dark olive-green color. When the conidia have arisen the infected tissue often assumes quite a dark color about its margin, which is usually well defined and nearly circular. Under the action of the parasite the affected piece soon dries sufficiently to shrink both in thickness and breadth. The shrinkage in breadth causes its rupture from the surrounding and more or less healthy tissue. It soon becomes entirely excised and falls to the ground. The opening left is bounded by partially dead and thickened tissue, and it looks as if made by fine bird shot. The entire effect resembles that produced on apricot, prune, almond, peach, and other leaves by the Australian "shot-hole" fungus, *Phyllosticta circumscissa*, Cooke. It is distinguishable, however, in most cases,

from the effects of that fungus, even to the naked eye. In many instances the openings in the almond leaf are bounded by the finer veins or vascular bundles. The midrib is rarely divided by *Cercospora*, and the larger secondary veins often prove an obstacle to its extension. In some instances cells are formed about the infested tissue of these circles apparently as a protective provision, and they are perhaps comparable to the transverse cells cutting off leaf petiole and blade when of no further use to the plant. More observations are needed to determine if this growth be common or exceptional. Where infection occurs near the margin of a leaf the opening left is semicircular, and resembles the work of the leaf cutter bee, *Megachile*. The outer effects of this fungus on the leaf are figured (Plate XI, Figs. 1, 5, 6). Figs. 5 and 6 are of the almond leaf, and represent the greater part of a leaf of natural size, with a smaller portion enlarged about 3 diameters. Fig. 1 is of a peach leaf badly infested by *Cercospora*, also natural size.

We learn through a study of the leaf tissues that all portions are involved in the effects of *Cercospora circumscissa*. The vessels are filled with a reddish, amorphous, gum-like deposit, the entire vascular bundle being involved in the discoloration. The compact upper palisade cells are shrunken and wanting in chlorophyll and amylaceous material; and this is also true for the lower, more openly arranged palisade cells or spongy parenchyma. The cell walls are yellowish, while the cell lumen usually contains a yellowish granular deposit in greater or less abundance. So far as observed, most of the chlorophyll bearing cells have their walls uninjured.

DISSEMINATION OF THE DISEASE AND PREVENTIVE MEASURES.

The small circular pieces of diseased tissue excised from the leaves of affected plants unquestionably provide for a ready spread of the disease. They bear near the center of one or both surfaces fascicles of abundant conidia. Prior to their fall from the leaf, these pieces of tissue commonly warp into the form of a watch crystal or even a cup. Moderately warped pieces are shown in cross section in Figs. 7 and 8, of Plate XI. The margin of the piece may warp either upward or downward, but in either case many fascicles of conidia are protected at the center of the concave surface from the touch of most external objects. The diameter of the cup-shaped pieces varies from 1 to 6 millimeters, and they may protect from one hundred to several hundred conidia. The spores arising from the convex surface are soon freed and scattered. Those within the concavity are retained much longer and until the pieces may be blown or carried by the water of irrigation for long distances. Unquestionably both the minute size and peculiar shape of the spore-bearing tissue greatly facilitate the dissemination of spores. Water readily separates the mature conidia from their conidiophores, and in case of a light shower they are freed and distributed over surrounding foliage in

vast numbers. Mist or fogs are not so apt to free the conidia,* but these are favorable to germination.

It is, perhaps, too early to consider preventive measures, as thus far no experiments, so far as I am aware, have been conducted to this end. There are one or two suggestions, however, which it may be well to make in view of the observations in the field and laboratory.

(1) Let all fallen foliage be gathered from beneath infested trees and burned.

(2) Have the earth beneath the infested trees carefully and completely turned under, the deeper the better.

It is important that spray applications of known fungicides should be made with thoroughness, both to trees and soil, to the latter after the fall of the foliage. In applying sprays to the tree it should be remembered that a great majority of the spores of *Cercospora circumscissa* are produced on the under surface of the leaves and branches.

OBSERVATIONS ON THE PARASITE.

The microscopical study of *Cercospora circumscissa* reveals much variation in form and habit. There are presented, by means of the camera lucida, some of the variations observed in the production and form of its conidia. There are also given numerous figures showing the characteristic but greatly varying habit of germination. (Plate XII.)

The conidia vary both in length and form. They are from 1 to 6 or 7 celled; mostly 2 to 5 celled. The distal one-fourth to one-half is usually reduced in transverse diameter and the cells are longer than those of the proximal portion. Toward the base of the conidium the cells are often somewhat distended at the equator. This gives the basal half a slightly undulating outline from septum to septum. The width of the distal end varies between 3 μ and 4 μ, while the greatest breadth taken toward the base varies between 4 μ and 6 μ. The basal cell contracts rather abruptly toward the end, to a transverse diameter about equal that of the distal end of the conidium. The length of the conidium is found to vary according to certain favorable or unfavorable conditions of growth. The most common variation is between 22 μ

* The formation and attachment of the conidia are examined with difficulty in water. When a section bearing conidia is placed in water the spores become free. This may be avoided by placing the sections upon the slide nearly dry and afterwards moistening them gradually by breathing beneath the cover glass. The condensed vapors soon gather about the conidia and answer the purpose of a water mount in the transmission of light rays, while the conidia remain attached to their conidiophores. Glycerine or water may afterwards be run under the cover glass with much greater safety. When profile views of attached conidia are desired it is convenient to cement the back of the spore-bearing leaf tissue to a section of cork 2 millimeters in thickness. When dry the cork serves as a firm support in sectioning; and, owing to its thickness, it insures that the section shall lie so that the desired profile view is obtained. The cork is removed by running water over the sections and then teasing them with a fine brush.

and 64 μ, but in many measurements I found conidia from 20 μ to 106 μ in length. One hundred measurements gave an average of 40.6 μ. The conidia have a straight or variously curved form, and even bifurcate examples occur. They are often enlarged upon one side, and it is common to find their course quite angular in places. Instances are observed where projections extend out laterally much as when germinating, although these projecting cells have heavy walls like the remainder of the conidium. Not infrequently the basal cell is pyriform. The walls of the conidium, as well as the transverse septa, are mostly about ½ μ in thickness, distinct, yellowish, and firm. The cell contents are of a clear yellowish color and finely granular. When the conidium has been in water for a few hours the cell contents become more distinct, and what seem like small oil drops appear and becomes aggregated at or near the ends of the cell. This is the first step in the process of germination.

In germination the contents of the individual cells of the conidium press toward the ends. There appears near either end of the cell a number of small, yellowish, refractive bodies resembling oil drops. These may also be distributed through the entire cell, although most abundant at the ends. The general contents of the cells become more distinct. Through endosmose the cell soon grows turgescent, and by the pressure towards the ends the walls become distended, leaving the equator of the cell with a less diameter than the ends. This is a direct change of the condition in the cell prior to the first steps in germination. At the ends of the conidium the enlargement may become almost knob-like before any germ tube is evident. At the extremes of the cells about to develop tubes, the protoplasmic contents become fine and clear, while the cell wall at these points soon disappears, and growth begins by the pushing out of the tube or hypha. In a large number of germinating conidia observed at various times, the germ tube has nearly always arisen directly from the end of the cell or from the angle between the cell wall and septum. In comparatively few cases germination takes place directly from the side of the cell. While the cell contents are being arranged preparatory to germination the entire conidium is often seen to be passing through a new stage of development. It curves to one side in such a manner as to allow the individual cells of which it is composed to partially divide from one another. In many cases this process of division is not carried further than to allow the separating cells to assume a position at right angles to each other, thus leaving the newly separated ends of each exposed. Though only a portion of the cells become wholly separate in slide cultures, it is probable that, were the germ tubes to penetrate a natural substratum, these half divided cells would separate. It is interesting to note what advantages may arise from this strange turning to one side of the parts of the conidium. In the first place it exposes a new and tender cellulose wall at the end of the dividing cells, admitting of an easy protru-

sion of the germ tube. It also provides that each germ tube shall be directed at an angle, often a right angle, to the direction taken by that of its fellow cell, insuring different points of infection. In case of the entire division of the cells of the conidium, still another aid to immediate dissemination is obtained. In one instance a germ tube was seen which originated from a second or inner cell, passed through the septum to the terminal cell and out at the end of the latter. (Plate XII, Fig. 23.) The germ tubes in moist cultures grow out into long mycelial hyphæ, which at an early stage appear destitute of septa, but when older the septa become distinct and often quite near together. The contents of the new hyphæ are quite clear and finely granular. The branches are not very abundant, but moderately so in some cases. They mostly arise at right angles to the parent hypha. The thickness of the parent hyphæ is well maintained through their length, although diminishing slightly to the end. There are, however, some cases where the hyphæ are enlarged or contracted at various points in their course. Conidia recently matured germinate in moist cultures very readily after a period of three or four hours; those having been matured several weeks germinate more irregularly and slowly.

The mycelium within the host plant is composed of hyphæ very similar to those of germinating spores. At points adjacent to the spore clusters the hyphæ are apt to make more or less abrupt turns, and at the angles they are sometimes considerably swollen. While culture hyphæ are rarely more than 4 μ in thickness, often considerably less, those near forming spore clusters in the leaf may reach 5 μ in thickness or even more. As the hyphæ branch and grow through the tissue of the leaf their thickness is reduced till those distant from the spore clusters are very fine. In general the hyphæ vary in thickness from 3 to 5 μ. They have been seen in all the tissues of the leaf, and nearly always occupy the intercellular spaces. They are seen to wind among the cells of the palisade tissue, in some cases going directly down between those cells to the more loosely arranged palisade tissue or spongy parenchyma as the case may be. I have seen numerous hyphæ in the epidermal cells, and one hypha passed for a considerable distance, from cell to cell, through the epidermis. The finer vegetative hyphæ are quite clear and are not easily distinguished, while their septa are seen with much difficulty. The larger hyphæ are more distinctly septate and the finely granular contents are rather indistinct. The walls are distinct under an enlargement of 500 to 800 diameters.

At or near the center of the affected leaf tissue the mycelial hyphæ become grouped, either within the epidermal cells or just below them. Here is formed a tubercular mass of heavy-walled cells, giving rise to erect thick-walled hyphæ or conidiophores. The tubercular mass when soaked for several days in water may be pressed and teased apart, so as to show that it is a compound body made up of groups of thick-walled storage cells supported upon a single hypha of the mycelium. These

thick cells give rise to from 1 to 6 or more conidiophores. I have figured the tubercular mass and several of the component groups of cells with their single hyphæ and varying number of conidiophores. (Plate XIII, Figs. 1–7.) The compound tubercular masses vary greatly in size, usually 3 to 15 μ in diameter. The number of conidiophores arising from them commonly varies from 20 to 50, but I have seen two well-developed conidiophores issuing alone from a stoma and having a well-defined tubercular base, with at least two distinct mycelial hyphæ springing from it. It is also common to find a greater number than 50 conidiophores in one fascicle.

The fascicle of conidiophores pushes through the epidermis, or, in some cases, through a stoma. The cuticle is raised, pierced, and broken by the pressure, and the conidiophores arise to a height of 14–43 μ or more. The walls of these conidiophores are rather thick, but not as dark in color as they afterwards become. The conidiophore may be simple with the basal part somewhat swollen, or it may be more or less twisted and curved. It is common to find the distal end sharply bent to one side and then turned upward, giving a shouldered form. Where this is repeated it forms a dentate end. I have seen at least five such irregularities in one conidiophore. From the tip of this straight, curved, shouldered, or toothed conidiophore arises the conidium already described. For stages in the growth of the conidium see Plate XI, Figs. 9–17. In some cases two conidia have been seen attached to the conidiophore at the same time. One arose from the curved tip, and the other from the shoulder of the conidiophore. From the number of curves made by the conidiophore it appears probable that several successive conidia are sometimes produced upon them. In transverse diameter the conidiophore varies between 3 μ and 5 μ, but when shouldered the tip is much reduced. The fascicles may be at first made up of slightly curving and mostly tapering conidiophores. They may present a mingling of the curved, shouldered, and toothed conditions, or else, especially when old, wholly composed of the shouldered and toothed forms. The matured conidiophore is capable of sending from its extremity a secondary growth in cases where much moisture is present. This new growth takes the form of a tubular prolongation, and in some cases observed it has produced terminal conidia. In one instance two conidia were attached to this secondary prolongation. The wall of this secondary growth is lighter in color than the basal matured portion. As shown in Fig. 8, Plate XIII, these secondary growths become shouldered as with the matured basal part. They become septate, and are separated from the base by a distinct septum. The mature conidiophores may also become sparsely septate. The attachment of the conidium to the conidiophore is very unstable. In some cases there is a membrane between the mature conidium and its conidiophore, which resembles a broad and short sterigma (Plate XI, Figs. 17 and 18).

EXPLANATION OF PLATES.

PLATE XI.

Fig. 1. Peach leaf infested by *Cercospora circumscissa*, Sacc., natural size and showing about forty-five points of infection. The circular pieces of dead tissue have fallen out in several places. The leaf was taken in October from a tree immediately adjoining a badly infested almond tree. Orchard of J. S. Baldwin, Orange, Cal.

2. Almond twig, new growth, infested by *C. circumscissa*, Sacc. From orchard of J. S. Baldwin, Orange, Cal. Natural size.

3. Almond twig, old wood (?), magnified 2½ diameters; *a*, the oval disk of tissue killed by the fungus; *b*, central, lighter, conidia-bearing portion; *c*, the fascicles of conidiophores; *d*, *d*, large portion of the side of the twig, probably indirectly killed by the fungus.

4. Transverse section through an almond twig partially killed by *C. circumscissa*, Sacc., enlarged 16 times; *a*, pith cells; *b*, xylem and xylem rays; *c*, phloëm and phloëm rays; *d*, cortical parenchyma; *e*, epidermis; *f*, cortical parenchyma killed by the parasite; *g*, fruiting bodies of the parasite; *h*, cambium tissue and xylem rays destroyed.

5. Almond leaf affected by the fungus, natural size.

6. Small portion of an affected almond leaf, magnified 3½ diameters; *a*, disk affected by the fungus; *b*, somewhat lighter, conidia-bearing center; *c*, crescent-shaped space left by the shrinking of the infected tissue; *d* and *e*, spaces where the tissue has been excised through the action of the parasite.

7–8. Transverse section of an affected spot in an almond leaf, showing the curvature of the tissue and the contained and protected fruiting bodies.

9–17. Conidia and conidiophores, the former in various stages of growth. The conidium at Fig. 17 is mature and separating from its conidiophore, show, ing at its base a vesicular membrane or sterigma occasionally observable. A large number of conidiophores of many forms, the straight, shouldered-curved, and more or less dentate forms are here shown.

18–29. Various forms of mature conidia, from those of 2 cells (Fig. 26) to those of 5 cells (Figs. 23 and 27). One bifurcate conidium is shown in Fig. 29.

30. Section of infested almond leaf, showing the fascicle of conidiophores resting on an indistinct, tubercular base, from which arise at least two hyphæ. The cells of the leaf are much shrunken and some of them are out of place, owing to the efforts made to free the mycelium from the tissue.

PLATE XII.

Figs. 1–3. Conidia of *C. circumscissa* prior to germination; *a*, enlarged extremities of the spores prior to germination, and showing the clear spot seen before the pushing out of the germ tube.

4. Conidium of 4 cells with newly formed germ tubes at *a a*.

5–9. Conidia of 2, 4, and 5 cells, with one or more germ tubes, unbranched and of various lengths. Figs. 6–9, *a*, show the gathering of the cell contents at the ends of the cells and the numerous refractive bodies found there at the time of germination or before.

10. Conidium of 5 cells after germination from the end cells; *a*, retracted condition of the equatorial portion of the cells just prior to germination.

11. Conidium of 5 cells with 2 germ tubes; *a*, a germ tube arising from the central cell at the angle between the lateral wall and the transverse septum.

Figs. 12. Conidium of 4 cells and 3 germ tubes; *a* and *b*, germ tubes arising directly from the side of the conidium.

13. Conidium of 3 cells and 2 germ tubes; *a*, *b*, branches arising from a germ tube near its base.

14–16. Three conidia previous to germination; turning in part to one side, and thus nearly separating the cells and causing them to stand at an angle to each other; *a*, *a*, *a*, points in the partly separated cells where the cell wall is not hardened and where the germ tubes usually arise.

17. Conidium of 3 cells having 2 germ tubes with its cells turned to one side, admitting of the germination of the central cell from the septum.

18. Conidium of 4 cells; *a*, 2 cells turned at right angles to the remaining 2; *c*, the outer cells of both *a* and *c* have already germinated; *d*, points where the germ tubes of the two interior cells should push out, the tube from one of these having already appeared, *b*.

19. Conidium of 3 cells and 4 germ tubes, *a*, *b*, *c*, *d*; *a*, germ tube arising from the inner end of a terminal cell.

20. A 5-celled conidium with two long. unbranched germ tubes extending at right angles to each other.

21. A conidium of 3 or 4 cells having 3 rather long, unbranched germ tubes.

22. A conidium of 3 cells and 3 germ tubes.

23. Interior germination. An inner cell has pushed out a germ tube, *a*, into and through the end cell of the conidium.

24. Conidium with several germ tubes, some septate and some branched.

25, 26. Conidia showing septate germ tube and branch. 25, *a*, septa; 26, *a*, branch.

27. Conidium with germ tube, showing many septa and branches. *a*, branches.

Germinations obtained in moist cultures. All figures enlarged 800 diameters.

Plate XIII.

Fig. 1. Conidiophores of *Cercospora circumscissa*, Sacc.; *a*, tubercular mass of thick-walled cells just beneath the cuticle of the affected almond leaf, *d*, supported by the mycelium, *c*, and bearing the conidiophores, *b*.

2. Two mycelial hyphæ, *a*, *a*, connected with the thick-walled storage cells, *b*, supporting the conidiophores, *c*.

3–7. Various portions of the conidia-bearing organs, similar to those of Fig. 2; letters as in Fig. 2.

8. *a*, First conidiophores, with dark heavy wall; *b*, a secondary or later growth from *a*, which is shouldered, *c*, and bears at the curved tip a forming conidium, *d*; *e*, septum.

9. Secondary conidiophores, *a*, *b*, bearing conidia, *c*, *d*; *e*, *f*, points of attachment of two conidia to the single conidiophore; *f*, shouldered attachment; *e*, special attachment.

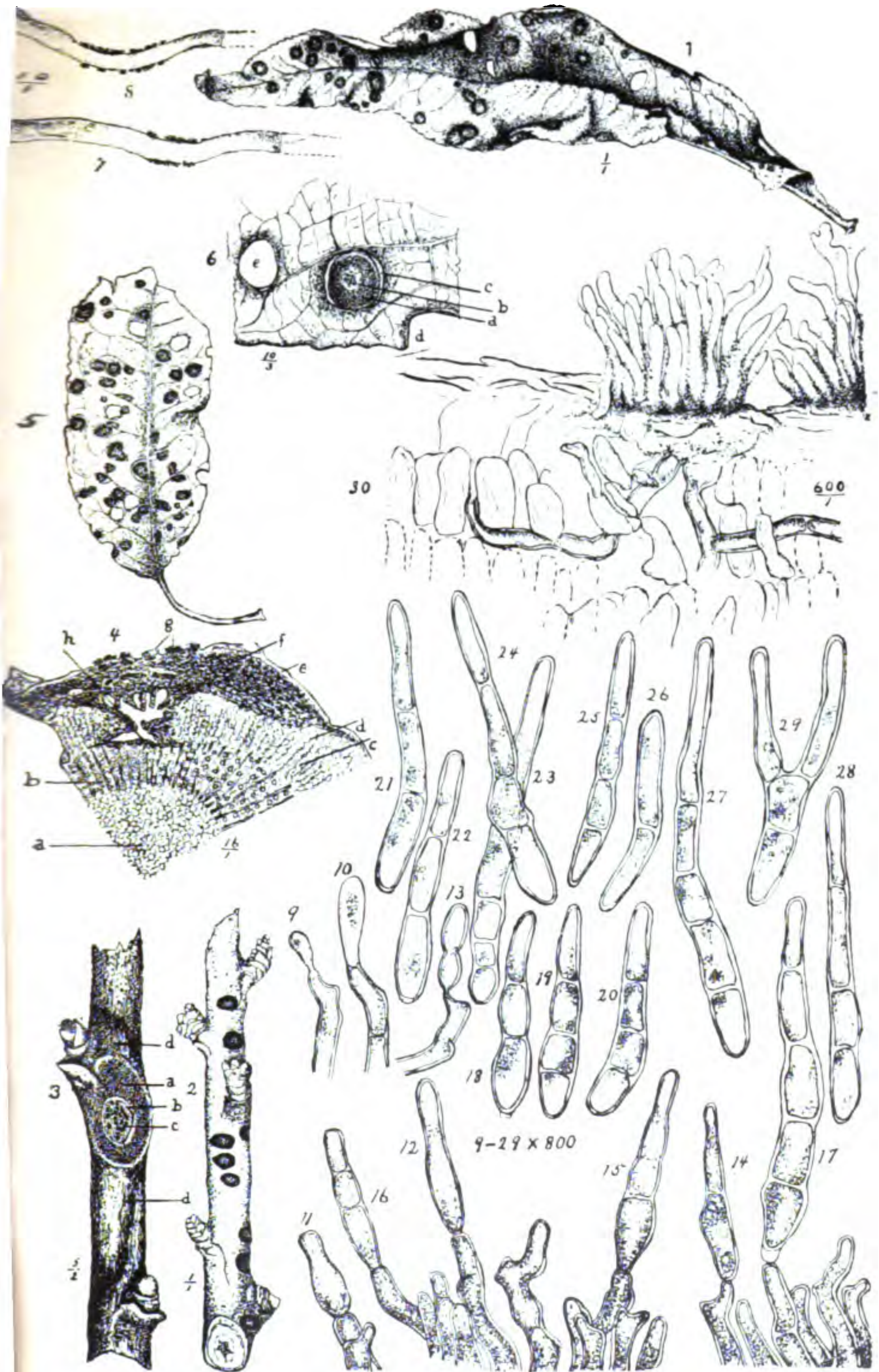
10. Fascicle of conidiophores, *a*, having thick dark walls and mostly shouldered or curved, with a secondary terminal growth, *b*. This terminal growth may or may not be septate beyond its point of origin, and is most commonly produced where there is much moisture.

11. Upper view of conidiophores.

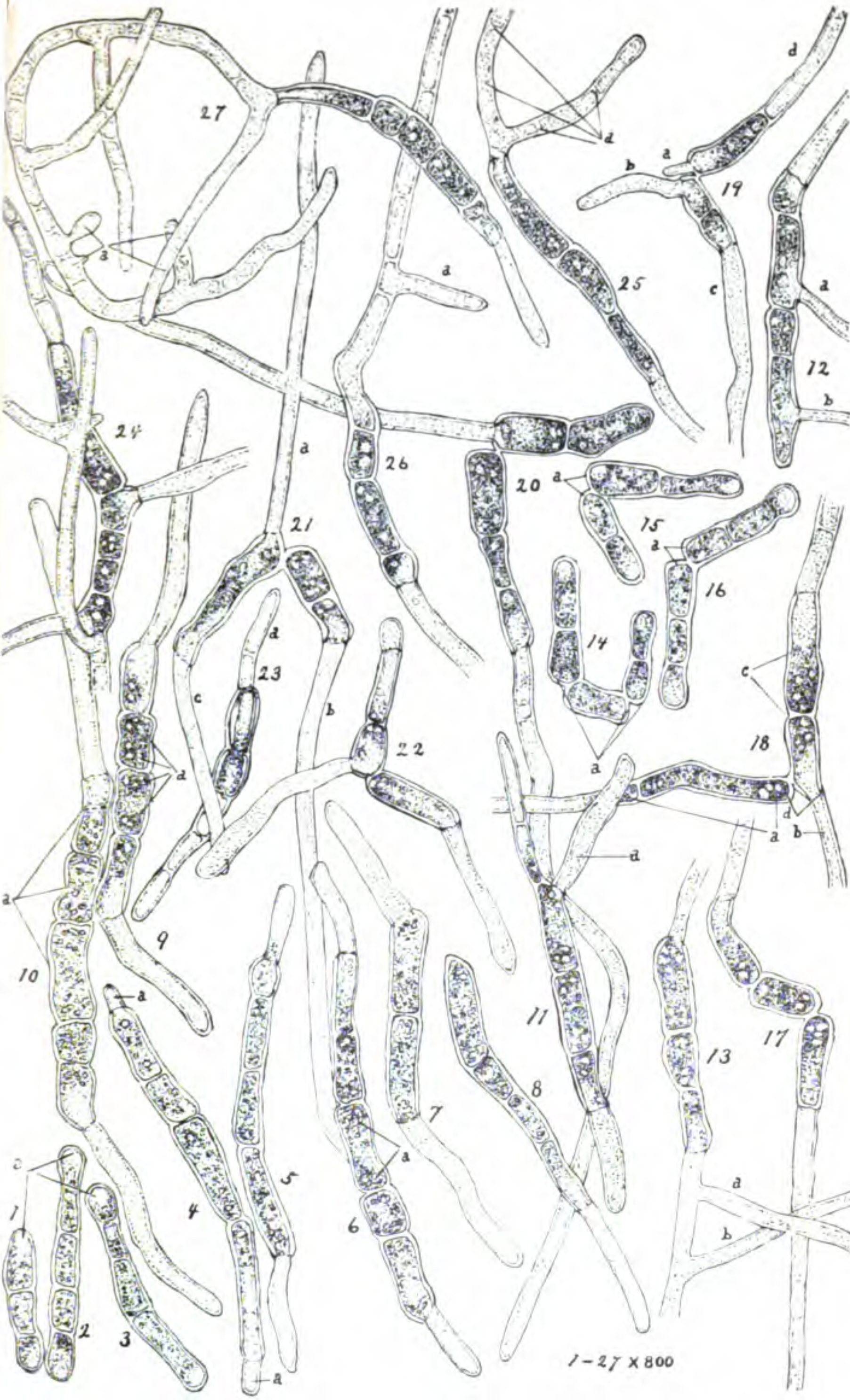
12. An old fascicle of conidiophores, showing the twisted and distorted forms which they often take after having produced conidia.

13. Fascicle of conidiophores, *a*, with numerous attached conidia, *b*. This shows that the distal portion of the conidium is that having the reduced diameter.

All figures from nature. Figs. 1–6 and 8–12 magnified 800 diameters; Figs. 7 and 13 magnified 600 diameters.



PIERCE ON ALMOND DISEASE.



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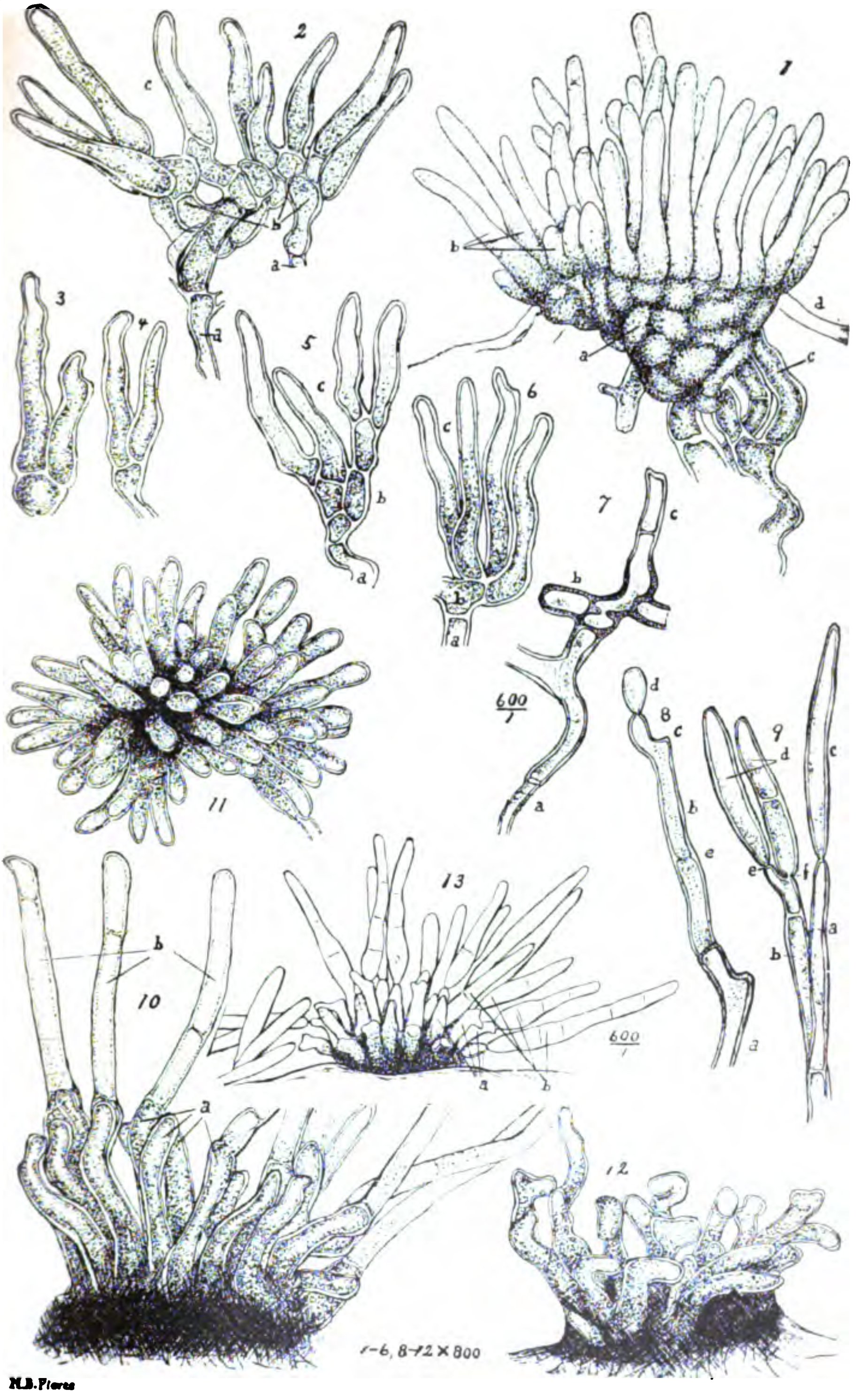

PIERCE ON ALMOND DISEASE.

ALMOND ORCHARD DEFOLIATED BY CERCOSPORA.

PLATE XIV.

An almond grove near Orange, Cal., prematurely stripped of leaves during July, 1891, through the action of *Cercospora circumscissa* Sacc., combined with the lack of sufficient moisture. Many terminal twigs of last year's growth are dead and dry. From photograph, August 5, 1891.

SUGGESTIONS IN REGARD TO THE TREATMENT OF CERCOSPORA CIRCUMSCISSA.

By B. T. GALLOWAY.

As stated by Mr. Pierce, no experiments of consequence looking toward the prevention of the disease under consideration have been made in this country. Some work, however, along this line has been undertaken in Australia, while a number of diseases of a similar nature are successfully treated every year in the eastern part of the United States. From these facts and from the life history of the fungus causing the almond disease, which Mr. Pierce has so fully set forth, we are able to make some suggestions in regard to treatment. In the first place it must be borne in mind that the foliage of the almond and peach is easily injured by both fungicides and insecticides. Bordeaux mixture, which we use successfully in combating various diseases of the pear, cherry, and quince, and which never injures the foliage of these plants, under certain conditions has been known to sometimes kill the leaves of peach trees and even in some cases to destroy young wood, fruit, and flowers. In our experience the ammoniacal solution of copper carbonate has proved the safest and best fungicide for the peach and almond. The formula we shall adopt in all our work the coming season is as follows:

Copper carbonate	ounces..	5
Aqua ammonia (26°)	pints..	3
Water	gallons..	45

The copper carbonate should be placed in an ordinary wooden pail and just enough water added to make a thick paste. Then pour in the ammonia and stir until all the copper is dissolved. If 3 pints of ammonia is not enough to thoroughly dissolve all the copper add a sufficient quantity to bring about this result. When completely dissolved pour the copper solution into a barrel holding 40 or 45 gallons, then fill the barrel with water. Where there are a large number of trees to treat we find it very convenient to prepare the concentrated ammoniacal solution in advance. This can be done at leisure, taking care always to put the liquid into a tightly corked jug or demijohn as soon as it is made. When ready to spray take the concentrated fluid into the field and for every three pints add 45 gallons of water.

In order to protect the foliage from the attacks of the *Cercospora* it would probably be best to begin the application of the ammoniacal so-

lution just as soon as the leaves appear. A second application should be made in ten or twelve days, followed by a third two weeks later. It is possible that three applications would hold the disease in check. Doubtless six or seven sprayings would be better and would pay in the end; three sprayings should be made as directed above, the others thereafter at intervals of two weeks. For applying the solution a good strong force pump provided with two lengths of discharge hose and two spraying nozzles is necessary. Any good force pump will answer, providing it is light and strong and the working parts are made of brass. We usually mount the pump on a barrel and attach two pieces of one-fourth inch cloth insertion hose, each about 15 feet long. At the end of each hose we fasten an improved Vermorel nozzle. About 2 feet of the hose is then wired to a piece of cane fishing rod, 8 or 10 feet long, allowing the nozzle to project an inch or two beyond the pole. The barrel and pump are then placed in a wagon while a man standing on the ground at each side of this outfit manages the nozzles. Another man stands in the wagon and in addition to looking after the horses does the pumping. By means of the long hose and poles the spray may be quickly directed over a tree on each side of the wagon. Two trees being sprayed in this way the horses are driven opposite two more trees when the spraying is again repeated. In this way a large orchard may be treated in a comparatively short time.

For trees from 12 to 15 feet high it will require about 1 gallon of the solution for each application. With an apparatus such as we have described a tree may be sprayed in one and a half or two minutes. Estimating the cost of the team and men at $6 per day, the copper carbonate and ammonia at 40 and 8 cents per pound respectively, each tree should be sprayed six times for 10 or 15 cents. The cost may be still further reduced by making the copper carbonate at home. Directions for doing this were published by us in Farmers' Bulletin No. 4, but for the benefit of Californians who may not have seen this publication, we give below the formula:

In a tub or barrel dissolve 6 pounds of copper sulphate in hot water. In another suitable vessel dissolve 7 pounds of sal soda in hot water. When the two solutions are cool, pour the second slowly into the first, then add water until the tub or half barrel is full. Stir the solution thoroughly and let it stand for twenty-four hours, then siphon off the clear liquid and add fresh water. Stir again, and again allow the solution to stand twenty-four hours; siphon off the clear liquid as before, then remove and dry the sediment, which is carbonate of copper. Using the above quantities of copper sulphate and sal soda there will be formed 2½ pounds of copper carbonate. Sal soda sells at wholesale for 1¼ cents per pound, so that on this basis the necessary chemicals to make 2½ pounds of copper carbonate will cost 46¼ cents, or 18¾ cents for 1 pound. The usual wholesale price for this chemical is 40 cents per pound.

It will be seen that it will not be costly or difficult to carry out the foregoing suggestions. It is to be hoped, therefore, that the treatment will be tried at least sufficiently to obtain some definite information on the subject.

CLUB-ROOT IN THE UNITED STATES.

By A. C. Eycleshymer.

(Plates XV, XVI.)

Since the disease club-root is forcing itself more and more upon the attention of American agriculturists, it is of the utmost importance that all the facts, at present known, concerning this destructive disease should be brought together, that the best means for its prevention may be suggested. With this end in view, a series of inquiries was addressed by the writer in 1889, to practical gardeners throughout the United States, and also to the officers of experiment stations and others likely to be able to give information regarding distribution, cause, remedies, etc. At the same time experiments were carried on in the hothouse, seedlings of cabbages and turnips being raised under conditions favorable for the development of the parasite and infected by mixing portions of diseased turnips with the soil. The correspondence and experiments were continued during two seasons. The results are communicated in the following preliminary report, as the work for the present has been interrupted, so that the series of experiments undertaken can not be completed.

The origin of the disease is not known. Its existence in Scotland was first detected in 1780, but little damage was caused until 1820. This is the earliest knowledge we have of the disease. It is at present known in England, Scotland, and Ireland, as ambury, anbury, hanbury, and fingers-and-toes. In Russia, kapoustnaja kila. Germany, kohlhernie. Belgium, vingerziekt. France, maladie digitoire. In the United States it is known by the various names, club-foot, club-root, clump-foot, and clubbing.

Its distribution in the United States is quite difficult to ascertain. There is no doubt, however, that its stronghold at present is in the New England and Middle States, especially in Connecticut, Rhode Island, Massachusetts, New Jersey, Delaware, and in the southeastern portions of New York and Pennsylvania. From this region it has extended southward through Maryland and Virginia to the Carolinas. The disease has occurred in Missouri, Illinois, Wisconsin, Iowa, and Michigan. Beyond the regions just named there is not sufficient evidence of its appearance.

The amount of damage caused by the disease is enormous. Woronin estimates the loss in the vicinity of St. Petersburg, Russia, for the year 1876, at $225,000. In the United States, wherever the disease is prevalent, it is considered one of the worst enemies of the market gardener, destroying in many cases the entire crop.

The plants affected are for the greater part confined to the genus *Brassica*, including the cabbage, cauliflower, turnip, and rutabaga. Halsted has recently described it as occurring on the radish. In Russia it also affects the genera *Matthiola* and *Iberis*.

The disease attacks the young seedlings and generally shows itself in from three to five weeks. It is first indicated externally by the so-called "flagging" of the leaves. The chlorophyll no longer shows the dark green color characteristic of perfectly healthy plants, but a lighter and yellowish tinge. Upon examining the roots of the plants thus affected there are found tubercular outgrowths or excrescences varying in size, according to age, from those scarcely distinguishable to those ten or twelve times the diameter of the normal root. These swellings seem to be confined exclusively to roots, never occurring on the stem or leaves.

Under the various names by which the disease is known probably many tubercular swellings have been described which bear no relation to true club-root. Buckman[7,*] for example, says: "Every field, whether of parsnips, carrots, or turnips, will contain roots affected with finger-and-toe," and claims this to be a reversion to their original wild form, but he has evidently given a description of the digitate appearance as distinguished from the smooth unbranched condition of well-developed specimens.

So closely do the characteristics resemble those present on the roots of the potato, tomato, and parsnip caused by a nematode that one would consider them, from a mere casual examination, to be identical. In speaking of these galls Atkinson[3] says: "In external appearance the enlargements of the roots of the Cruciferæ, which are called club-foot, very much resemble the root galls. Unless one was pretty certain of the locality from which the diseased specimens came, it would be venturesome to undertake to say whether it was root gall or club-foot."

Another form of tubercular swelling is that found on various specimens of Leguminosæ (clover, beans, peas, vetches, etc.) described by Ward[32], Brunchorst[6], Schindler[28], Tschirch[3], Prazmowski[23], Beijerinck[4], and others. Since there is considerable variation on the roots of different species, there might arise some difficulty in distinguishing these from club-root. Seignette has recently described swellings probably due to variation of temperature. The fact that various forms of excrescences on roots are plainly due to widely different causes indicates the necessity of discrimination in order to avoid confusion.

Careful examination of the outgrowths occurring on the roots and rootlets of the genus *Brassica* show the elongated, fusiform swelling to be more characteristic of those occurring on the cabbage (Plate XV, Fig. 1), while those on the turnip are round or oval (Plate XV, Fig. 2). Extended comparison of diseased turnips and cabbages give no support to the view of W. G. Smith that the cause of the disease can be predicted from the form of the swellings. To the unaided eye these outgrowths, especially in the earlier stages, do not seem to differ either

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* The numbers given after authorities refer to the bibliography at the end of the paper.

internally or externally from the sound tissue. In the later stages there is a change from pearly white to a yellowish brown. Instead of a smooth convex outline the surface is full of fissures, secondary fungi gain access, decomposition begins, and the foul odor arises which is so characteristic of the disease. These appearances are especially noticeable in the turnip. (Plate XV, Fig. 3.)

In the study of the minute anatomy use was made of freehand sections. Serial sections were also used to a considerable extent, the material being embedded in celloidin and cut with the microtome. Sections through stem and leaf show no trace of any parasite. If a transverse section of one of the spindle-like swellings of the cabbage be cut along the line *a*, *b* (Plate XV, Fig. 4), where the hypertrophy is least marked, and examined with a low power, a more or less mottled appearance is seen (Plate XV, Fig. 5). This is due to the presence of the parasite *Plasmodiophora brassicæ*, Wor.[37], which is undoubtedly the principal cause of the club-root disease. A very noticeable feature is that, in general, this appearance is found in the vicinity of the cambium *c* and tracheæ *tr* of the axial portion. Examination with a higher power shows this mottled appearance to be due to the presence of minute spherical bodies, which are so densely packed that the entire lumen of the cell is filled. Sections of the turnip along the line *a b* (Plate XV, Fig. 6) show different stages in the development of the Myxomycete. There is often found in the same section all the transitional stages between the plasmodium and mature spores (Plate XV, Fig. 6ᵃ *a*, *b*, *c*). The individual cells of the thin-walled parenchyma undergo a marked hypertrophy. This is shown by comparing Figs. 7 and 8. The drawings are made from the same section taken along the line *c d* of Fig. 6, Plate XV. Fig. 7 shows the normal tissue of the cambium zone taken from the right side, while Fig. 8 shows the pathological condition as it occurs on the opposite side. If the peripheral layers *a* be made to coincide, a comparison is readily made. Moreover, this swelling is noticed in cells surrounding those infected and where no trace of the parasite could be found. Yet this is not sufficient to account for the enormous tubercles shown in Plate XV, Figs. 1 and 2. This would seem to justify Woronin's[37] statement that the swellings are not only caused through the hypertrophy of individual cells, but also by an increase through cell division. The tracheæ apparently undergo no changes. Plate XVI, Fig. 9, taken from a section along the line *a b* of Fig. 10 shows one of the vessels more highly magnified. It is completely filled with the plasmodium, while the surrounding tissue is free from any trace of disease. This at once suggests that the parasite may thus be readily carried to different parts of the tissue. If now the contents of the cells of the medullary rays be examined they are found, in the normal tissue, to be loaded with starch. Comparing the pathological tissue from the same region a marked change is noticed. Instead of the small cells well stored with reserve food, we have the

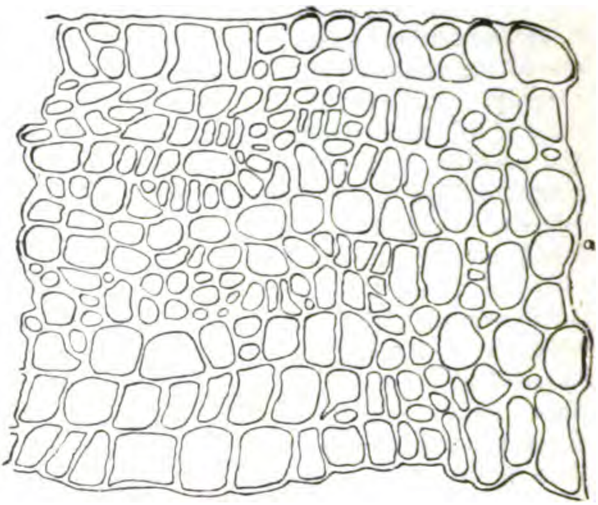

Fig. 7.—Transverse section along line *cd* of Plate xv, Fig. 6. The portion represented is taken from the normal tissue found on the right side, × 200.

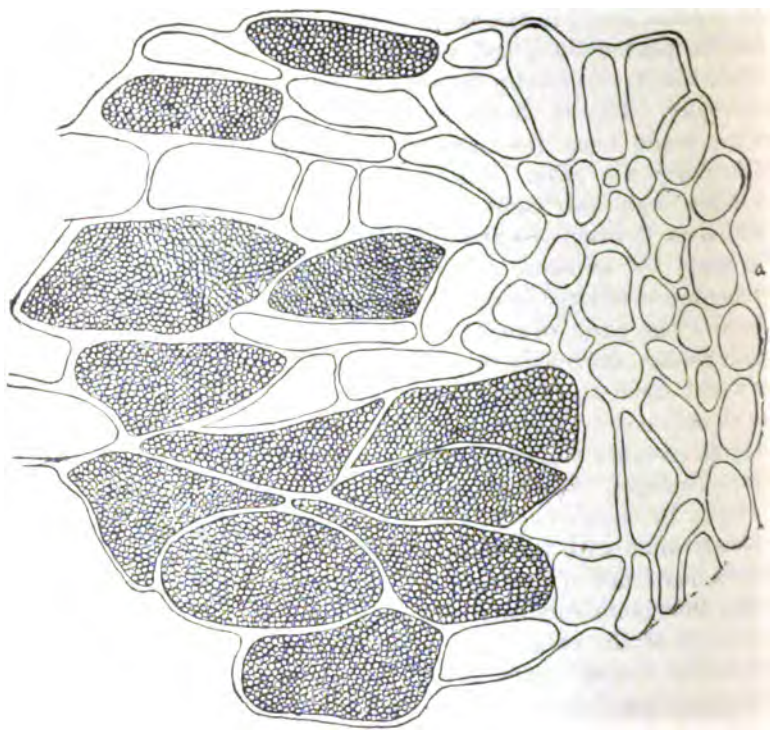

Fig. 8.—Transverse section along the same line *cd*, but taken from the left side, × 200.

enormously swollen cells shown in Plate XV, Fig. 6[a], in which there is no trace of the starch, *i. e.*, so far as could be determined by the use of iodine. Testing with Schulze's solution, or hydrochloric acid and phloroglucine, a lignified condition of the cell walls is found, though to a less degree than in the regions where the cells are entirely filled with spores. Often the cells of the cambium are so pressed out of shape that the tangential walls alone are distinguishable.

If a bit of the tissue, in which spores are found so abundantly, be placed under a cover glass and lightly tapped the spores are set free. If the slide be now placed in a moist chamber and allowed to remain from four or five to twenty-four hours, the swarm cells are distinguished either on the slide (Plate XVI, Fig. 11), or escaping from the spores (Fig. 12). The appearance of the swarm cell after escaping is that of an irregular protoplasmic mass which undergoes greater or less changes in contour. Plate XVI, Fig. 11 *a*, *b*, *c*, *d*, *e*, *f*, *g*, represent the changes of outline through which one of the swarm cells passed in about fifteen minutes. A very much elongated process, cilium, is often observed (Fig. 11*a*). The nucleus is often plainly visible (Fig. 11*e*, *f*). Nothing could be determined as to nuclear changes. It seems fair to suppose, however, that these correspond to what has been observed in other Myxomycetes. It is in this stage of its existence that the organism is supposed to penetrate the root hairs, and thus gain access to the deeper parts of the cortex. Repeated endeavors were made by means of slide cultures to observe the penetration of these swarm cells, but without success. This is a point that needs further observation. The penetration has never been observed, and it is possible that it is through ruptures in the tissue, caused by insects, worms, or other forms, which are constantly present in the soil. If the slide be kept in a moist chamber for four or five days, other and larger forms are present (Plate XVI, Fig. 13), while the swarm cells have almost entirely disappeared. It is quite probable that the larger forms result from a fusion of the swarm cells, but direct proof is wanting. These forms undergo the same changes of outline as described for the swarm cell (Plate XVI, Fig. 13*a*, *b*, *c*, *d*). A nucleus is plainly visible and a pulsating vacuole is present. It is worthy of note that in the tissues these forms are never observed, while in slide cultures they are very abundant. Another condition observed is represented in Plate XVI, Fig. 14, and may be designated as an early plasmodial stage. In most cases it does not at first fill the entire lumen, and more or less branching filaments extend to the walls of the cell, often apparently continuous with the plasmodium of the adjoining cell. It often presents a somewhat aggregated appearance (Plate XVI, Fig. 14). Vacuoles are always present. They are, however, of a decidedly different nature from those found in the forms represented in Plate XVI, Fig. 13. In that, no pulsation is observed. Nuclei can not be observed by the use of ordinary nuclear stains; acetic methyl green; picric aniline blue; acetic carmine, etc. The absence of starch in all cells occupied by plas-

modia leads one to strongly suspect it has been digested by the mass. Dr. Wortman performed experiments which seem to show conclusively that the plasmodium of Fuligo took in and digested starch grains. It is highly probable that the same takes place in the plasmodium above described. In this would be found an explanation of the fact already referred to, that in the medullary rays of diseased parts no trace of the starch can be found.

Passing to stages which are probably later, since they occur in tissue where ripe spores are very abundant, the plasmodium is found filling the entire lumen of the cell and presenting a reticulated granular appearance (Plate XV, Fig. 6ª *a*). Another appearance often noticed is represented in Fig. 6ª *b*, where the granules have an aggregated aspect. These are probably changes immediately preceding spore formation, Fig. 6ª *c*. A very peculiar appearance of the plasmodium is shown in Plate XVI, Fig. 15. The significance of this is unknown. A possible explanation might be the irritation caused by the presence of bacteria, but a series of transitional stages between those indicated in Plate XVI, Figs. 15 and 16, were observed.

The ripe spore is composed of a thin, transparent, refractive outer portion inclosing a more or less granular matrix, in which are embedded bodies of varying size, form, and refractive power (Plate XVI, Fig. 12). The nature of the bodies could not be determined; they may be nuclei or oil globules. From each of these spores a swarm cell escapes into the soil, where it may come in contact with the rootlets of the young plant.

Among cabbages, and in fact all members of the genus *Brassica*, there seems to be no variety exempt from attack. Many varieties were sown in the same soil under similar conditions, and so far as could be determined no differences were present. From correspondence the same conclusion is reached. It is claimed that the rutabaga is less liable to attack than the common variety, and when sown in alternate drills with "purple top" they produce a fair crop, while the latter is much affected. As to the variety of radishes attacked, no information is at hand. It is now generally conceded that the disease occurs after all kinds of crops. The market gardeners consider it dangerous to grow cabbage or turnip crops on the same ground for even two successive years. Rotation is absolutely necessary. After a cabbage or turnip crop all débris should be carefully removed and burned.

It has been claimed that early sowing was the cause of the disease. While this is untenable, there is undoubtedly a great tendency for early sown crops to become infected, especially if the season be a wet one, thus making the conditions for the germination of the spores more favorable. The disease is said to be more prevalent along trodden paths indicating that the rolling of ground is unadvisable.

There can be no doubt that the disease is propagated to a considerable extent through the decayed material left on the field. Yet one is puzzled to account for the well established fact that it is found occa-

sionally on newly broken ground where no crop has ever yet been grown. This would seem to indicate that certain soils harbor the organism as a saprophyte. Poorly drained ground often shows the same tendency. The soils otherwise best adapted for cabbage growing are those on which the organism can survive best, *e. g.*, bogs and swamps which are rendered arable, but crops grown on sandy loam are less subject to the disease, as are also those grown on calcareous soils. Wherever a limestone formation outcrops both cabbages and turnips are comparatively free from attack. Some of the Long Island gardeners raise cabbages season after season on the old shell heaps without any trace of the disease.

It often occurs that turnips or cabbages grown on ground previously covered with compost heaps show the disease, while the plants all around them are free. Fertilizers should not be spread over the ground in the autumn, since it is known that the various kinds of manure form an excellent substratum for the development of certain Myxomycetes. If applied, it should by all means be thoroughly fermented.

It is quite evident, from the nature of the disease, that after having gained access there is probably no cure. Preventives are apparently the only means by which the ravages of the disease may be averted. Probably the want of clean cultivation is one of the most fruitful sources by which the disease is propagated. Of all the various preventives, ashes, salt, chalk, lime, bisulphide of carbon, etc., suggested by both gardeners and scientists, lime seems to be the most effectual. If applied to the land during the spring immediately preceding, it very seldom has any effect on the ensuing crop, but if applied a year and a half before, it almost invariably has a surprising effect in preventing the disease. It is only by extended experiments that the best methods of application can be determined. Since many believe the disease originates largely in the hot-bed before transplanting, sterilization of the soil should be tried. Mixing certain proportions of unslaked lime with the soil used in the hotbed will undoubtedly modify, to a considerable extent, the occurrence of the disease. Hulst[16] makes a saturated aqueous solution of chloride of lime, sold by druggists as "bleaching powder." This solution is diluted with three parts water and applied to the roots of the plants and to the surrounding soil at the time of transplanting. In from two to three weeks this is followed by a second application.

In conclusion, I wish to call attention to certain forms that are almost constantly present. Sections of tissue containing plasmodia are rarely examined in which there are not present minute bodies undergoing vibratory movements very similar to that known as the "Brownian movement." The granules are very large, and indeed so much do they resemble micrococci that one is led almost irresistibly to the conclusion that this is the explanation. If this be true it is questionable to just what extent we are dealing with true plasmodia. Ward[32] finds the so-called plasmodia described by various authors as occurring in the tubercles found on the roots of *Vicia Faba* to be nothing more than the pro-

toplasm of the cells, stimulated into increased activity by parasitic gemmules. While there is but little doubt that *Plasmodiophora brassicæ*, Wor., is the principal cause of club-root, it is by no means improbable that bacterial forms play quite an important part. Pure cultures should be made of the various forms so generally present and inoculation experiments tried.

I hereby desire to acknowledge with sincere thanks the assistance I have received through the kindness of Prof. Spaulding, under whom the work was begun and has been carried thus far. I am indebted to Dr. Erwin F. Smith of the Division of Vegetable Pathology of the U. S. Department of Agriculture, to Dr. Byron D. Halsted of the New Jersey Experiment Station, and to Mr. George A. Schultz, of Jamesburg, N. J., who kindly furnished me with material. To the botanists of the various experiment stations and other correspondents, whose suggestions have been of much value, I am also under obligations.

UNIVERSITY OF MICHIGAN, *February 14, 1891.*
BOTANICAL LABORATORY.

BIBLIOGRAPHY.

The list appended is not at all complete, but comprises all the works consulted. Many I have not seen in the original, brief abstracts alone being available.

1. Adam. Agriculture, vol. II, p. 51. London, 1789.
2. American Agriculturist. January, 1867; August, 1868; August, 1869.
3. Atkinson, George F. Preliminary Report on Root Gall. Science contributions Agr. Exp. Sta., Auburn, Ala., December, 1889.
4. Beijerinck, M. W. Die Papilionaceenknöllchen. Bot. Zeit., 1888; Rev. in Bot. Cbl., Bd. 38, 1889, p. 458.
5. Bird, James. Disease in Turnips. Trans. High. Agr. Soc., 1857–'59, p. 307.
6. Brunchorst. Über die Knöllchen an den leguminosen Wurzeln. Ber. d. Deut. Bot. Ges., Bd. III, 1885, p. 241; Abst. Bot. Cbl., Bd. XXIV, 1885, p. 333.
7. Buckman, James. Finger-and-Toe in Root Crops. Jour. Roy. Agr. Soc., 1853–'54, p. 125.
8. Country Gentleman's Magazine, vol. I, 1868, p. 40.
9. Curtis. Insects affecting the Turnip Crop. Jour. Roy. Agr. Soc., 1841, p. 193.
10. Dickson's Agriculture. London, 1807.
11. Donaldson's British Agriculture, 1838, p. 556.
12. Duncan, James. Report on Cause of Finger-and-Toes. Trans. High. Agr. Soc., 1859–'61, p. 197.
13. Farquharson. Communication Respecting Diseases in Turnips. Trans. Highland Agr. Society, 1830.
14. Heinzelmann, F. Die Kohlkrankheiten. Schweizer. Landw. Zeitschr, 1882, pp. 526–530.
15. Henderson, P. Club-root in Cabbages. Country Gentleman. Albany, N. Y., 1879, p. 807.
16. Hulst. Club-root. Bull. Agr. Exp. Sta., N. J., Dec., 1888.
17. Hunter, W. B. Finger-and-Toe in Turnips. Trans. Highland Agr. Soc., 1855–'57, p. 347.
18. Kühn, Jul. Wurzelfeinde des Kohls. Deutsche Landwirthsch. Ztg., Bd. XXI, 1878, No. 85.

19. Loudon. Encyclopedia of Agriculture, 1838, p. 861.
20. Low. Practical Agriculture, 1838, p. 301.
21. Michigan Farmer, vol. 4, pp. 13, 136, 148.
22. Milburn, M. M. Experimental Investigations on Finger-and-Toe in Turnips. Jour. Agr., 1853–'55, p. 73.
23. Prazmowski, A. O istocie i znaczeuiue biologicznem brodawek korzeniowych grochu. (Das Wesen und biologische Bedeutung der Wurzelknöllchen der Erbse.) Ber. aus den Sitzung. der K. k. Akad. der Wissensch., 1889, June. Rev. in Bot. Cbl., Bd. 39, 1889, p. 356.
24. Regel, E. Die Kropfkrankheit des Kohlpflanzen. Regel's Gartenflora, 1879, p. 170.
25. Rostrupp, E. Kaalrödder medel Knolddannelser foraanisagede af Plasmodiophora Brassicæ Wor. Meddelelser fra Botaniske Forening i Kjöbenhavn, No. 7. 1885, p. 149. Rev. in Bot. Jahrb., Jahrg. 13, 1885, vol. I, p. 304.
26. Russell, R. Cause of Finger-and-Toe in Turnips. Jour. Agr., 1857–'59, p. 529.
27. Sanderson, James. Report on Finger-and-Toe. 1859–'61, p. 37.
28. Schindler, F. Ueber die biologische Bedeutung der Wurzelknöllchen bei den Papillionaceen. Jour. f. Landwirth., Bd. XXXIII, p. 325; Abst. Bot. Cbl., Bd. XXVII, 1886, p. 108.
29. Sorauer. Pflanzenkrankheiten. Part 2, Berlin, 1886, p. 66.
30. Stevens. On the Disease of Turnips, commonly called "Fingers-and-Toes." Jour. Agriculture, 1828, p. 429.
31. Tschirch, A. Beiträge zur Kenntniss der Wurzelknöllchen der Leguminosen. Ber. d. Deut. Bot. Ges., 1887; Bot. Cbl., Bd. 31, 1887, p. 308.
32. Ward, H. M. On Tubercular Swellings on the Roots of Vicia Faba. Phil. Trans. Roy. Soc., London, vol. 178, 1888, p. 539.
33. L'H., G. Clubbing in Cabbages. Gard. Chron., new ser., vol. XII, 1879, p. 442.
34. Wilson, A. S. Club-root Fungus. Gard. Chron., new ser. vol. XII, 1879, p. 392.
35. Wittmack, L. Bemerkung über Kropfkrankheit des Kohlpflanzen. Monatschr. d. Ver. z. Beford. d. Gartenbaus i. d. k. pr. Staaten, 1879, pp. 444–445.
36. Woronin. Nachträgliche Notiz zur Frage der Kohlpflanzenhernie. Bot. Zeit., 1880, p. 54.
37. Woronin. Plasmodiophora brassicæ. Prings., Jahr. f. wiss. Bot., vol. XI, 1878, p. 548.

EXPLANATION OF PLATES.

PLATE XV.

Fig. 1. Specimen of diseased cabbage, after Woronin. Natural size.
2. Specimen of diseased turnip root, after Sorauer. Natural size.
3. Portion of transverse section of turnip. Natural size.
4. Rootlet of cabbage showing condition seven weeks after infection. Natural size.
5. Transverse section of rootlet along the line *ab* in which the spores are present, × 65.
6. Portion of root of turnip seven weeks after infection. Natural size.
6*a*. Cells from tranverse section along line *ab* Fig. 6, × 200.

PLATE XVI..

Fig. 9. Vessel from axial portion. Section taken from along line *ab*, Fig. 10, × 600.
10. Diseased rootlet of cabbage. Natural size.
11. Swarm cell drawn at short intervals to show constant change in outlines, × 1,200.
12. Ripe spores from some of which swarm cells are apparently escaping, × 1,200.
13. Probably early stages of plasmodia, × 600.

Fig. 14. Normal plasmodium as found in early stages of the disease, × 600.
15. Aggregated appearance of plasmodium × 300.
16. Section showing another aggregated appearance in which the spherical masses are much smaller, × 200.

FIELD NOTES, 1891.

By Erwin F. Smith.

It can scarcely be doubted that climatic conditions exert a marked influence on the spread of many fungous diseases. Bad weather may render the host more susceptible, or only afford the parasite increased facilities for multiplication, or both. Under just what set of conditions in particular cases the fungus is most likely to attack the host, or is certain to do so, are points on which, for the most part, there is not yet enough evidence to decide positively, but as time goes on we may confidently expect to see many of these problems worked out fully, our knowledge of the complex relations of host and parasite being yet only in its infancy.

In this series of notes my desire is simply to put on record certain observations which may contribute toward the solution of a most interesting problem of phytopathology. There is no doubt that mycologists must become closer observers of local weather conditions and of the individual, varietal, and specific peculiarities of plants, if they would satisfactorily explain the behavior of many fungous diseases.

PEACH CURL.*

It is well known that gardeners and fruit-growers have frequently ascribed this disease (mildews, also) to the depressing influence of cold. Mycologists, on the other hand, since the discovery of Taphrina, have, perhaps too generally, assumed the direct cause to be the only necessary factor in the production of curl.

The conditions under which peach curl appeared in the orchard of Mrs. W. O. Shallcross, at Locust Grove, Md., in the spring of 1891, are so peculiar and bear so directly on the point at issue that it seems worth while to set them down somewhat fully. This orchard contains about 1,050 trees, now set five years. It is situated on the east side of Chesapeake Bay, on loose, thin upland, in a region of extensive orchards, the nearest being about one-half mile distant. Peach curl due to Taphrina is not troublesome in eastern Maryland or Delaware. It was present in quantity for the first time in many orchards in Kent County, in 1890, and was so much more than usually abundant everywhere as to receive notice in this Journal (Vol. vi, p. 107). Probably there was more or less of it in this orchard, but not enough to attract special attention.

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* *Taphrina deformans* (Berk.), Tul.

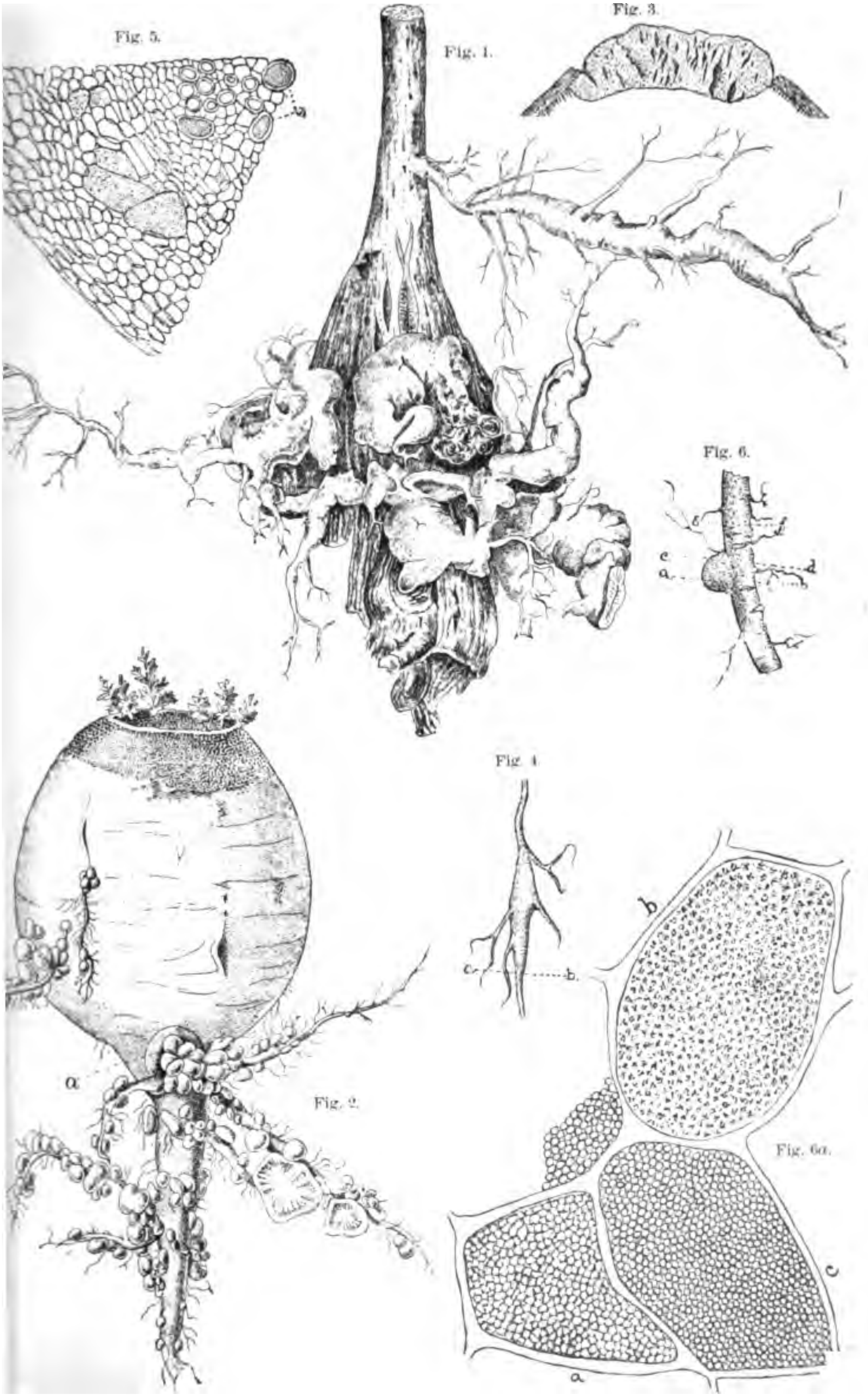
Fig. 5.
a
Fig. 1.
Fig. 3.
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Fig. 9.

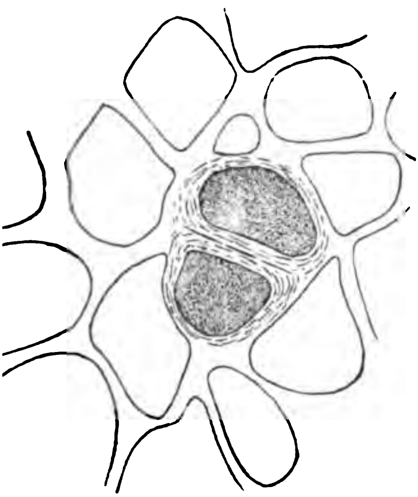
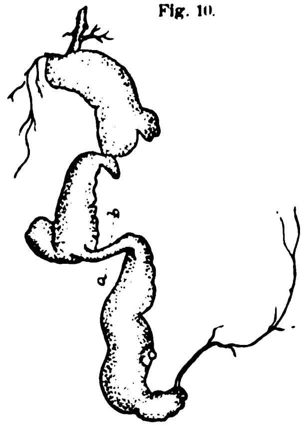


Fig. 10.



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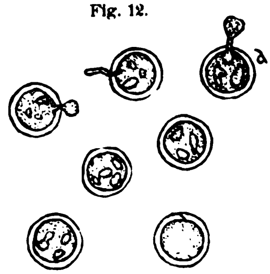


Fig. 11.

Fig. 13.

Fig. 16.

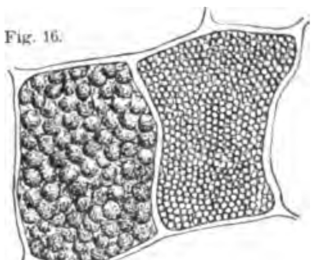


Fig. 14.

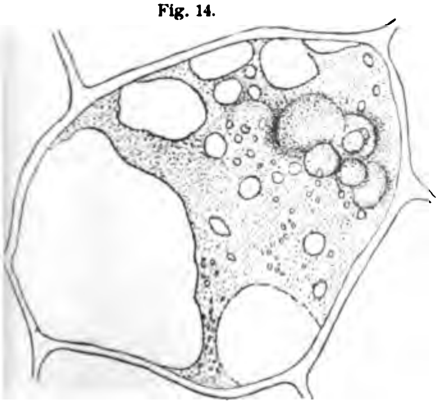
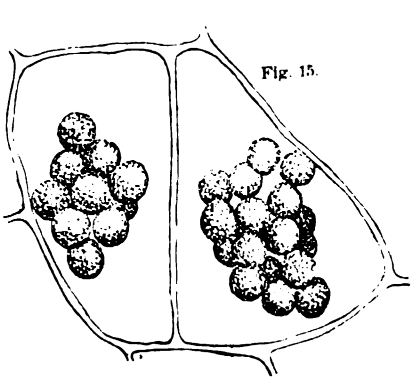


Fig. 15.



EYCLESHYMER ON CLUB-ROOT.

The orchard contains cases of peach yellows, and alternate strips have been under treatment since the autumn of 1889, and consequently the entire orchard has been subject to frequent inspection. The following examinations were made in the spring of 1891:

April 16 every tree was carefully examined in all parts above ground for symptoms of yellows. This was to determine whether any new cases had appeared since fall. The tentative diagnosis of new cases was based principally on the color and state of advancement of the unfolding leaves, and for this reason the inspection of the foliage of each tree was minute. The leaf buds had been open about two weeks, and some varieties were then in blossom. The weather for a week had been dry and pleasant.

April 20 the fertilizers were put on. The foliage was much larger than on the 16th and growing rapidly, influenced by warm weather and a heavy thunderstorm on the night of the 18th. The fertilizer was harrowed in on the 21st, but the orchard was not plowed until May 7. The application of the fertilizers consumed most of the day, during which I passed from row to row through all parts of the orchard seeing every tree. With one exception all the varieties were then done or nearly done blossoming, and the petals were on the ground.

April 23 the orchard was revisited and two strips were limed. Again many of the trees were examined closely. All varieties were done flowering and some forward fruits had begun to burst the "cap."

During these three visits I observed no trace of Taphrina. On the last visit the older leaves were 1–2 inches long.

May 1 I revisited the Shallcross orchard, and was surprised to find peach curl on nearly all of the trees. There were thousands of affected leaves, and the curl was the first object to attract attention. The orchard was visited to secure buds for inoculations, but the curl was so abundant that difficulty was experienced in finding cuttings free from it.

This great outbreak of Taphrina came upon the trees during the last week in April. The minuteness of the observations on April 16, 20, and 23 fixes the date beyond reasonable dispute. There was no noticeable curl prior to April 23, and the orchard was full of it from one end to the other on May 1.

Prior to the 24th the weather was warm for a whole week, and vegetation was tender and growing very rapidly. Following this and during the week in which the curl developed came a sudden cold wave of three days duration. On Thursday the 23d, the temperature reached a maximum of 80° F. On the 24th it dropped to 54°–64°; on the 25th it was 44°–64°; and on the 26th it was 40°–62°, with a slight frost in low places.* The next day it was warm again, the range being from 50°–80°.

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*The minimum records are those of early morning (sunrise), and do not represent the lowest temperature of the twenty-four hours. All were recorded by Dr. W. S. Maxwell, Still Pond, Md.

This coincidence is suggestive, to say the least, and I am inclined to believe that the sudden drop in the temperature had something to do with this sudden and very unusual prevalence of the curl. Probably some other unknown factor also favored the development of the fungus in this particular orchard, *e. g.*, some soil condition. This is the more likely because no other orchard under observation was anywhere near so badly attacked.

PEACH MILDEW.*

This mildew has been found occasionally since 1887, but never upon many trees in any one orchard. It usually attacks the leaves and young stems. On the latter it forms a dense, felt-like, persistent hyphæ-complex which is first white and afterwards a dirty gray, the epidermis being cracked open and destroyed or much injured and a thick brown layer of cork being formed under the mycelial patches. The mildew produces conidia in abundance, but perithecia have not been found, although the search has been continued into winter.

In Maryland and Delaware particular trees are attacked year after year and become stunted, while surrounding ones escape. Often only one or two trees in an orchard will be attacked. This fact has been so noticeable during the last five seasons that it seemed probable the disease was brought from the nursery. Its persistence on certain trees and the freedom of others was only explainable on the hypothesis of some individual peculiarity which I was unable to discover.

This year the mildew was observed in Maryland, Michigan, and Georgia, and in central Michigan it was more than usually prevalent. At Hubbardston it attacked a dozen very thrifty seedlings in the fifth year of growth and apparently for the first time, defoliating the tops of the trees in June and July and causing a new growth of leaves and branches not unlike incipient hexenbesen. In this case the origin of the mildew is unknown, but in case of a Maryland tree known (!) to have mildewed in 1889 and 1890, the fungus was found on the unfolding shoots so early in the spring and to such an extent as to make it almost certain to have wintered over in the form of perennial mycelium. Several hundred leaves and stems were covered with white mycelia and conidial fruits prior to the time of blossoming, and in some cases almost before the buds were open. No perithecia could be found on this tree and no mildew this year or last year on any of the neighboring trees. From other trees fresh looking mycelium has been taken in midwinter, and I have no doubt as to its perennial nature.

Later in the season Mr. J. W. Kerr, of Denton, Md., called my attention to four yearling peach trees which were badly mildewed, although they had been grown from fruits procured by cross fertilization and did not have the same parentage. The most conspicuous point of agreement was the absence of glands at the base of the leaf blade. Mr.

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* *Sphærotheca pannosa* (Wallr.) Lev. (?).

err stated that during a large nursery experience he had observed ees bearing leaves destitute of these large glands to be specially subet to mildew. Other nurserymen have observed the same fact, even long ago as the days of Downing. This, in connection with the fact at mildew is rare in the eastern United States and that most of our chard varieties possess glandular leaves, led me to make careful obrvations during the remainder of the year. The tree above referred as attacked in early spring bore leaves destitute of glands.* So so the twelve at Hubbardston, Mich. In fact, frequent observations the orchards of several States brought to light everywhere the same irious correlation. *Trees with gland-bearing leaves were free from milew, and mildewed trees bore leaves destitute of glands.*

One exception only in perhaps 150 cases was noted; a tree with slight ildew and traces of glands. The same correlation has also been oberved, according to Mr. Wickson, in California. It would seem, therefore, as though peach trees of the type bearing glandular leaves are nore resistent to this mildew than other varieties, but whether this vill hold good for all localities and all varieties remains to be seen.

BLACK SPOT OF PEACHES.†

This disease was unusually prevalent on the Delaware and Chesapeake peninsula. Indeed, I have never before known it to be one-fourth as abundant. All kinds were attacked, even the early and midseason varieties which usually escape. Many fruits were very badly spotted and unsalable. Very often also the spots coalesced into broad patches covering one-third to one-half of the peach. The side attacked was dwarfed. The flesh under the black patches was unusually solid and ripened very slowly, remaining greenish and bitter when the other side was fully ripe.

The observations of this year confirm earlier ones and lead me to think that dry weather is not favorable to the development of this fungus. During the growth and ripening of the fruit, rains occurred at frequent intervals and there was no dry spell such as usually occurs. January, February, March, and the first week in April were also rainy, and the winter was mild; no zero weather.

FROSTY MILDEW.‡

This parasite evidently flourishes best in shady places. It was unusually common on the Chesapeake and Delaware peninsula in the fall of 1891, especially on trees bearing dense and late-ripening foliage. In previous seasons I have also noticed it most abundant on the foliage of highly fertilized trees, especially those given nitrogen or complete fertilizers and growing late into autumn. For example, in the same

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* These glands secrete a fluid sought after by bees and other insects.

† *Cladosporium carpophilum*, Thm.

‡ *Cercosporella persica*, Sacc.

region in 1890 it was rare on unfertilized trees, but very common on those which received complete fertilizers, especially on the lower and inner leaves. The conidia develop on the under surface of the leaf, often in restricted areas visible above as yellow or yellowish green patches with definite margins. Very late in the season, before the fall of the leaves or afterward, pycnidia develop on the conidial surface and in the body of the leaf in such a manner as to lead one to believe them a part of the cycle of development. These were first observed in 1890 and again in 1891. Other bodies similar to the phoma conceptacles, but destitute of spores, accompany these, and a search toward spring would perhaps reveal the presence of ascospores, and might lead to the determination of the true position of this form-genus.

PEACH RUST.*

Puccinia pruni-spinosæ occurs but rarely in this latitude (39°), and then mostly on thickly planted nursery stock. In Georgia it is more abundant, but there also it appears to prefer nurseries to orchards. Last year and this year it did not attack the trees until after June. In a yard at Griffin a number of small seedlings were free from rust the 1st of last July and so badly affected when reëxamined in November that it was almost impossible to find a sound leaf. Most of the leaves bore dozens of sori. The upper surface of the leaf was either a uniform yellowish green or a bright green with sharply defined yellow spots corresponding to the sori on the under surface. As in another locality the preceding year, the leaves nearest to the earth were observed to be most badly attacked. The autumn of 1891 was very dry, the first rain of two months occurring on November 10. At Vineyard, Georgia, in 1890, it was also observed that the fungus spared the parent tree but attacked the foliage growing from buds which were taken from it and set into seedlings in another locality on June 23.

PEACH ROT.†

In eastern Maryland and Delaware it rained every few days during the peach season, and was frequently warm and cloudy between showers. In consequence the brown rot, due to *Monilia*, was very prevalent. The blight of blossoms and twigs has already been described in Vol. VII, pp. 37–38, of this JOURNAL. In some cases as many as twenty blighted blossoms were found on a single twig, but in spite of all accidents the peach crop above the frost line was enormous. The abundance of this fungus in 1891 contrasts strikingly with its rareness in 1890, when there was no fruit, and raises the question how it tided over the year of famine.

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* *Puccinia pruni-spinosæ*, Pers.

† *Monilia fructigena, Pers.*

PEACH YELLOWS.

This malady has been more than usually prevalent in parts of the eastern United States. There was great complaint of premature fruit in the mountains of western Maryland; on the upper part of the Chesapeake and Delaware peninsula; in portions of Pennsylvania and New Jersey; in Connecticut, and at Fennville, Mich., where they have neglected to remove diseased trees. The disease was also found for the first time at Ann Arbor, Mich. This is a profitable peach region, somewhat isolated from other peach districts of the State. Cases to the number of more than 150 were discovered in midsummer. They were in ten different orchards, and in one or two the evidence indicated that the disease had been present more than one year, probably two or three years. The disease seems to have broken out first in the orchard of J. D. Baldwin, in trees brought from New Jersey. Seventy-five diseased trees were removed from this orchard and forty-five from an adjoining one. All affected trees have been destroyed, and a vigorous effort will be made to prevent the extension of the disease.

Examinations in early spring of trees known to have been healthy the preceding autumn showed that it is possible to diagnose a certain number of cases before the trees blossom, but not all of them. The first symptoms of the disease may appear at any time from early spring to late autumn.

CLUBBED BRANCHES.

Complaints have been received from Michigan and New York of a nursery trouble which renders peach trees unsalable without permanently injuring them. The terminal buds are killed, and side buds push, giving to the top a branched, stunted, clubbed appearance, not unlike that occurring naturally in certain varieties, *e. g.*, of Hinman and Garfield. The injuries appear to be done in May or June, and specimens were received too late in the season to determine the cause. This trouble has been present in both States for at least two years. Whole blocks of trees may be affected. They are said to make good roots and to grow out of the trouble the following season.

In specimens sent in more recently from Ohio many of the secondary branches were much thickened at the base, very spongy, and easily compressed. A microscopic examination showed many dry cavities in the xylem cylinder and an almost complete absence of lignification, the characteristic stains with lignin reagents being confined to the vicinity of the pith and to a few scattered bundles of wood fibers. A large number of trees in the middle of a nursery were seriously injured.

STEM AND ROOT TUMORS.

Irregular, tuberform, rough, warty outgrowths on the stem and roots of the peach at or just beneath the surface of the earth have been unusually common in nursery stock this year. Specimens were collected

in the District of Columbia and middle Georgia, and were received from California and Missouri. Some of these growths were as much as 2 inches in diameter, *i. e.*, much larger than the stem itself. Sorauer reports similar swellings on apple and pear trees, and ascribes them to mechanical injuries.

PEACH ROSETTE.

This disease is on the increase in Georgia, and its contagious nature has been settled beyond dispute.* Root grafts have been made to determine whether the contagion exists in all parts of the tree or only in the top. Cross inoculations have also been made, peach on plum and plum on peach, to determine experimentally whether the peach and the plum rosette are identical. Other experiments are in progress.

PLUM BLIGHT.

This disease (see Vol. VI, p. 108, of this JOURNAL) has done less than the usual amount of damage in Georgia, but there have been some cases.

PEAR DISEASES.

The pear crop on the Delaware and Chesapeake peninsula was enormous and quite free from scab (*Fusicladium*) and the spot disease due to *Entomosporium*. Pear trees were in full bloom at Chestertown and Still Pond, Md., on April 19, and the first scab was found on May 3, when the young fruits were about one-fourth inch in diameter. Two hours search brought to light only twenty-five scabby fruits. During blossoming and immediately after, the weather was dry, and there were two cold waves, April 24–26 and May 4–6. The records of Dr. Maxwell seem to show that pear scab has been abundant whenever there has been a combination of wet weather and high temperature during and immediately following the time of blossoming, and not troublesome in other years. Should additional observations confirm this view, there is in it a hint as to the years when treatments for scab will be most necessary.

The first Entomosporium spots were found on the leaves April 21. The damage in Maryland and Delaware in 1891 was confined principally to the leaves. These fell so early that many orchards blossomed and renewed their foliage in late autumn. The leaves of the Kieffer pear were not injured. This variety is noticeably resistant.

With the exception of one orchard, there has been no pear blight† worth mentioning in the vicinity of Still Pond; Md., in five years. The large commercial orchards have been remarkably free from it. These

* Additional Evidence on the Communicability of Peach Yellows and Peach Rosette. Government Printing Office, Washington, D. C., 1891.

† *Bacillus amylovorus* (Burr.) De Toni.

consist principally of Bartlett, Howell, Duchess d'Angoulême, Lawrence, and Kieffer. Choicer varieties blighted badly in years past, and their cultivation was abandoned.

SYCAMORE BLIGHT.*

The Sycamore disease due to *Gloeosporium nervisequum* appeared suddenly at Dover, Del., between May 6 and 14. A special examination of a large tree was made on the first date to discover the blight, because it had appeared on the tree in previous years. Not a trace was found, but having occasion to pass the same tree a week later, dozens of blighted shoots and dead and drooping leaves were found on all parts. Immediately preceding this attack came a cold snap. On the morning of the 4th there was a white frost, on the 5th it was very cold, with a black frost at night, which destroyed the peach crop on flat lands. On the 6th it was still colder with a fall of hailstones. Following this and during the week in which the blight appeared came a hot spell. It was very warm on May 9, 10, and 11.

NEW FUNGOUS DISEASES OF IOWA.

By L. H. Pammel.

The following paper treats mostly of new diseases of plants, but reference will also be made to a few that have been the subject of recent papers. Its scope will be limited to such diseases as have been destructive to farming and horticultural interests during the past year in Iowa, since to do justice to the subject over the whole country would take too much time and space.

The subject can naturally be divided as follows:

I. Fungi affecting forage plants and cereals.
II. Fungi affecting fruits and fruit trees.
III. Fungi affecting forest trees.

To the farmer in Iowa the diseases under the first head are of the greatest importance since the wealth of the State depends largely upon successful grain and forage crops.

I.—FORAGE CROPS AND CEREALS.

Diseases of wheat.—Aside from the usually common grain rusts (*Puccinia graminis*, and *P. rubigo-vera*) a serious disease of the wheat has appeared in the so-called "blight," or "scab," as the disease is called in different parts of the country. This disease causes the upper part of the

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* *Gloeosporium nervisequum*, (Fckl.) Sacc.

head to dry up and ripen prematurely. Although I have not made a thorough study of the disease it seems to be due to a fungus described by Worthington G. Smith* as *Fusisporium culmorum*. The genus *Fusisporium* is placed by Saccardo with *Fusarium*. In all probability Smith's species is one of the others affecting grains, but I have not compared them. The mycelium of the fungus is white or yellowish and permeates the kernel and flower. According to Smith the spikelets are glued together by a gelatinous substance produced by the threads and this causes their death. The hyphæ when placed in a nutrient solution produce an abundance of fusiform septate spores. It should be remembered that the genus *Fusarium* contains many representatives which are entirely saprophytic. Thus *Fusarium solani*, which is destructive to tomatoes, is not able as Prof. Galloway† has shown, to cause rot unless the tissues are somewhat disorganized. *Cladosporium herbarum* is not an uncommon fungus on "blighted wheat heads," and Frank‡ has shown that it is parasitic on the heads and leaves of various grasses. This disease seems to have been known for a long time in Iowa. Prof. Bessey so stated at the Indianapolis meeting of the Society for the Promotion of Agricultural Science; and it is also found in many parts of the United States, as Prof. Galloway stated at the same meeting. Dr. Weed has found it very destructive in parts of Ohio. Some varieties are more subject to the disease than others. Thus winter wheat was not subject to it nearly as much as some of the most highly prized of the hard wheats like the Saskatchewan.

Diseases of Barley.—Barley on the college farm at Ames this year, aside from the "rusts" and "smuts," has been subject to two diseases. One, *Scolecotrichum graminis*, Fuckl.,§ which has long been known as a serious pest to orchard, timothy,‖ and other grasses.¶ The diseased leaves are marked with brown, or purplish brown, spots, which appear on the leaves transversely. The hyphæ, which are sometimes septate, make their way through the stomata and bear the small brownish spores at the end, or sometimes laterally. The fungus occurred on all of the varieties.

The other fungus is *Helminthosporium graminum*, Rabh. This appears earlier and is more destructive. Mr. Ellis, to whom specimens were submitted, writes that the fungus is, without doubt, Rabenhorst's *Helminthosporium graminum*, and this is the same as *H. inconspicuum*.

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* Diseases of Field and Garden Crops, p. 208.

† Report U. S. Dept. Agriculture, 1888, p. 339.

‡ Krankheiten der Pflanzen, p. 580.

§ Trelease, Dept. of Agrl. Report 1886. p. 129, Plate VII. Ellis, N. Am. Fungi, No. 1988 *a* and *b*.

‖ Bidrag till Kannedomen om vara odlade vaxters sjkdomar. pp. 185, pl. 9. Sorauer Just Bot. Jahresb. 1885 p. 502.

¶ Saccardo Sylloge fungorum, Vol. IV. p. 348.

C. & E.* and Passerini's *H. turcicum.*† The specimens in Ellis's North American Fungi were found on dead leaves of *Zea Mays.* Passerini's specimens were also found on the species, and he attributed it to the fungus he has described. Briosi and Cavara‡ have described, figured, and distributed the same fungus in their collection of parasitic fungi. In their spores these species seem to agree well enough with Rabenhorst's *H. graminum*, which was found by Caspary§ on barley. Frank|| considers it to be only a well developed *Cladosporium.* In 1885 Eriksson¶ found a disease on barley, near Upsala and Stockholm, which he considered identical with that found by Caspary on barley in Germany. The Iowa barley disease agrees with Eriksson's, but differs from the corn disease found by Passerini. According to this observer the leaves of corn affected by the fungus are at first yellow, then become more or less discolored, and finally wilt.

The spots in the specimens distributed by Briosi and Cavara on corn are sharply limited and extend across the veins. This disease manifests itself long before barley has "headed out." In this barley disease the spots extend from the base to the very tip of the leaf in parallel rows. The diseased leaves form quite a contrast to those of the adjoining healthy plants, as they are variegated pale yellow and green. All the stalks of a stool are affected. The plants die prematurely, and soon after death the leaves become torn into shreds. An examination of the affected parts when the variegated linear stripes appear shows a colorless mycelium permeating the tissues of the leaf. Later a number of erect septate hyphæ appear through the stomata or they break through the epidermis, bearing large three to six celled spores at the end. Occasionally one finds these hyphæ branched. The mass of brown hyphæ and spores along the veins can be easily seen with the naked eye. The spores germinate readily, often a number of germinating tubes coming from a single spore. I have also found the *Helminthosporium* where *Scolecotrichum*, and *Cladosporium graminum* had appeared, but not in such abundance.

The usual amount of smut has occurred during the past summer. *Ustilago segetum* of oats, barley, and wheat and *U. Maydis* of corn have done an unusual amount of damage. Grasses have also been affected by several kinds of smut, some of which are quite destructive.

Timothy Smut, (*Tilletia striæformis* (Westd.) Magnus).—Not only did

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*Ellis N. Am. Fungi No. 45. Grevillea Vol. VI, p. 88.

†La nebbia del granturco. pp. 3. Parmia Schroter Just, Bot. Jahresb. 1878, p. 184.

‡Fungi Parassiti delle piante cultivate od utili essicati delineati e descritti. Fasc. III and IV, No. 81.

§Herbarium Mycologicum No. 332.

||Krankheiten der pflanzen, p. 582.

¶Ueber eine Blattflecken Krankheit der Gerste aus den Berichten der Botaniska Söllskapet i Stockholm. Bot. Centralbl. Vol. XXIX, p. 89. Sorauer Just Bot. Jahresb., 1885, p. 515. Distributed in Fungi Scand. No. 187.

this fungus occur on timothy growing on the campus, but quite seriously in the field as well. It is known to occur on many grasses in Europe* like *Alopecurus*, *Briza*, *Poa*, *Anthoxanthum*, *Milium*, *Holcus*, *Avena*, etc. In this country it is known to occur on *Agropyrum repens*, *Elymus Canadensis* var. *glaucifolius*.† I think it does not generally occur here on blue grass, but I have found it on that host in Cambridge, Mass. Last summer it was also found on the same host at Ames, where it was growing among timothy, forming the same lead-colored patches it does on that grass. I did not, however, observe that the leaves were afterwards torn into shreds, as it was cut soon after the fungus appeared. Very likely it does so, as it seems to be common when fungi attack grasses, especially along the veins of the leaf.

Brome Smut, (*Ustilago bromivora*, Fisch. de Waldh. var. *macrospora*, Farlow.) *Tall Meadow Oat Smut*, (*Cintractia aveneæ*, Ellis and Tracy).—Early in June Mr. F. A. Sirrine called my attention to several smuts occurring on some of the cultivated grasses in the plats of the experiment station. The first (*Ustilago bromivora*, Fisch. de Waldheim) is apparently the variety *macrospora*‡ of Farlow. It occurs abundantly on one of the best of our native species of *Bromus* (*B. breviaristatus*) and it has been reported on *B. ciliatus*, by Dr. Halsted. It affects the inflorescence so as to completely destroy it. This smut will probably not occasion much loss, as it attacks the inflorescence and the grass can be cut before it appears, but it must greatly injure its vitality.

The second destructive smut was found on *Avena elatior*. This was more common than the Brome smut and seems to be the same as has been found by Prof. Tracy in Mississippi on the same host, and called *Cintractia aveneæ*, Ellis and Tracy.§ It transforms the ovary into a compact mass, which is made up of small brownish spores.

This year *Ustilago panici-miliacei* (Pers.) Wint., was very common on *Panicum capillare* and *P. sanguinale*, completely destroying a large number of the plants. Last year it was noticed abundantly only on the latter host, none being found on *Panicum capillare*. It was observed on the latter by Prof. Arthur|| some years ago about Ames. This fungus does not seem to differ from *U. syntherismæ* occurring on the sandbur (*Cenchrus tribuloides*), and unless experiments have been made to decide whether Panicum smut can be transferred to the sandbur and *rice*

* J. B. De Toni in Saccardo Sylloge Fungorum, Vol. II, p. 484. Winter Die Pilze. Vol. I, p. 108. The following hosts are given by Winter: *Agrostis stolonifera, A. vulgaris, Calamagrostis Halleriana, Milium effusum, Holcus lanatus, Avena elatior, Briza media, Poa pratensis, Dactylis glomerata, Festuca ovina, F. elatior, Bromus inermis, Lolium perenne.*

† Trelease, Smut of Timothy. Dept. of Agrl. Report. Ellis North American Fungi. No. 1498.

‡ Bull. Iowa Agrl. College, 1886, p. 59. Saccardo Sylloge fungorum, Vol. VII, p. 461. Winter l. c., Vol. 1, p. 77.

§ Journal of Mycology, Vol. VI, p. 77.

|| Bull. Iowa Agrl. College, 1884, p. 172.

versa, they should be placed together. I mention these cases to show how destructive some fungus diseases are some years and they do not appear at others.

Clover Rust, (*Uromyces trifolii*, Alb. & Schw.) Wint., is referred to by Prof. Dudley in a recent bulletin as occurring on red clover in New York in a very destructive way. I think it has not been previously reported on that host in this country, though occurring abundantly on it in Europe, according to Frank, Kraft, and others. Clover rust has long been known to occur on white clover in this country, and is at times quite destructive. In August my attention was called to the rust occurring on the campus close to the botanical laboratory. The plants affected were somewhat trodden, but nearly every stalk had its leaves badly diseased. The affected plants soon withered. After the first discovery the rust was soon noticed some 30 feet away, attacking the leaves and stems. It was quite general, as students brought specimens in from the field and various places on the college farm and campus. During the months of August, September, and early October, only uredospores were found, but later teleutospores were produced very abundantly. The stems were marked with longitudinal brownish sori so thick that in touching the plant the hands were colored brown. The teleutospores made their appearance first on the stems, and later they appeared on the petioles and leaves.

Uromyces trifolii also occurs on crimson clover (*Trifolium incarnatum*).* Some years ago it was very bad in an experimental plat at Madison, Wis. The fungus is more destructive to this plant than to red clover. It has also been found on the same host at Ames by Mr. Sirrine. In this country the fungus has been principally reported as destructive on white clover, and commonly all three stages occur on it. Miss Howell has recently shown that the fungus on red and on white clover is identical, and that the uredo and teleutospores can be produced from the æcidium which appears early in the summer.

II.—FRUITS AND FRUIT TREES.

Plum Scab or Black Spot.—For two seasons I have watched with some interest a fungus which causes the plums of some of the cultivated varieties of *Prunus Americana*, especially the Miner, to become spotted and more or less scabby. So far as I know this has not been recorded before, though Professor Osborn informs me he has observed a similar appearance for some years. It is not improbable that the disease may be quite common in the Northwest. The cause of the spotting is a parasitic fungus which seems to be closely related to the fungus causing the black spot disease of peaches (*Cladosporium carpophilum.*) The last species was described by Felix Von Thümen in 1887 † and he records

* Trelease Parasitic Fungi of Wisconsin, No. 152, p. 21.
† Symb. Mycol., p. 107.

it as very troublesome in that year and the year before. Recently Prof Arthur * has recorded it as very widespread in Indiana, and Dr. Erwin F. Smith † as quite destructive in Delaware, Michigan, etc. Professor Galloway, who has kindly allowed me the use of his unpublished notes, records it as very destructive in many parts of the United States. The principal loss results from unattractive peaches and premature decay, due to *Monilia fructigena* and other saprophytic fungi. In Texas I have seen many peaches affected by it, especially the late varieties. The plum fungus differs in some respect from the peach, but this may not be sufficient to make a new species.

So far I have only found the fungus on the fruit, but the peach fungus is recorded by Prof. Galloway on the leaves as well. When plums begin to ripen, or are just turning in color, small round patches not larger than a pin head make their appearance. They are pale greenish or grayish in color. These spots increase in size till in some cases they are half an inch across. They are usually round, with a somewhat paler border. In older specimens the patches are frequently confluent and of darker brown color. In very old specimens, especially in those where the fruit has undergone decomposition, the patches become black and uneven.

An examination of the small grayish spots shows a nearly colorless mycelium creeping over the surface. In the darker portions of the large patches are septate hyphæ. In some cases these can be seen to come through cracks in the cuticle They are irregular in outline and frequently bent. As the material becomes older a dense stroma of short brownish hyphæ appears. It lies between the cuticle and the cellulose layers of the cell wall. In cross section the hyphæ are more or less angular in appearance, but when free they are rounded. This stroma, especially under favorable conditions, keeps on producing the erect septate hyphæ, which bear the slightly colored spores at the end. They are oval in form, pointed at the end, and usually two celled. The spores germinate readily when kept in a moist chamber, producing a colorless tube.

The fungus itself does not impair the qualities of the fruit, as the injury is little beyond where the spot appears, affecting only three or four layers of cells underlying the spot. Outside of the spot the tissues have their normal appearance. The cell contents of the affected parts are brown and dead. This death of cells causes a loss of water, and, as a result, small cracks appear in the cuticle through which the hyphæ can readily enter the plant. But this entrance, so far as I have observed, is only superficial, never in the epidermal layer, nor even beyond the cellulose layer of the cell wall of the epidermal cell. It is not uncommon to find large cracks or rifts through the outer patches. Plums affected by this fungus invariably show *Monilia fructigena*, putrefactive

* Bull. Agrl. Experiment Station, Indiana, No. 9, 1889.
† Jour. Mycology, Vol. v. p. 32.

bacteria, and less commonly *Rhizopus nigricans*, which cause a rapid decay of the fruit. A number of affected plums were placed in a moist chamber and these were soon covered with a vigorous growth of *Monilia*, its mycelium spreading in all directions. Its growth subsided in a few weeks, when mycelial masses were formed.

The plum fungus seems to differ chiefly from the one occurring on peaches in the shorter hyphæ and somewhat smaller spores. Those on the peach are occasionally borne laterally. The more vigorous hyphæ of the peach may be due to physiological causes. Mr. Ellis, to whom specimens were submitted, thinks it is a distinct species.

Anthracnose of currants, (*Glæosporium ribis* (Lib.) Mont. and Desm.).—Attention has been directed to this disease by several investigators.* It is very destructive, causing the leaves to become spotted on the upper surface, and to fall long before the proper time. Sometimes the leaves drop early in August. The spores come from small dark-brown specks. When ripe the epidermis breaks, allowing the spores to ooze out in tendrils. It is most commonly found on *Ribes rubrum* at Ames.

Two other destructive diseases have also appeared on currants. One is caused by a species of *Septoria*. The spots are at first brown, later becoming pale on the upper and brown on the under surface. Each spot has a number of small conceptacles, which contain the slender spores. Another disease found on *Ribes rubrum* causes a similar spotting but does not contain conceptacles, the hyphæ breaking through the epidermis and bearing the *Cercospora* spores. Both of these fungi cause the leaves to drop prematurely. The Septoria disease is the more destructive.

Cylindrosporium padi, Karsten.—It has become practically impossible to grow good cherry seedlings on account of this fungus. Leaves begin to fall early in June, and where cherries are budded the young growth continually produces spores throughout the season.

The cluster cup fungus of gooseberries (*Æcidium grossulariæ* DC.) has been very destructive to cultivated gooseberries and a common cultivated shrub, *Ribes alpinum*. It not only affects the leaves but causes the fruit to become greatly distorted and worthless.

Black knot (*Plowrightia morbosa*), although occurring abundantly on a large number of hosts of the genus *Prunus*, is especially destructive to wild plums and cherries in this State (*Prunus Americana*, *P. serotina*, *P. Virginiana*), frequently causing the death of the plant in a few years. It is not uncommon to find it on *Prunus domestica*, and within the last year it has been found on one of the Chinese apricots (*Prunus Armeniaca*) on the college grounds. The tree upon which the fungus was found has been subject to much pruning, and possibly infection has been brought about in this way. It is not improbable that

*Dudley, Agric. Exper. Sta., Cornell Univ., Ithaca, Bull. 15, p. 196; Peck, 38th and 43d Report N. Y. State Mus. Nat. Hist., p. 98, 6; Seymour, American Garden, Vol. XI.

the pruning has lowered its vitality and rendered it liable to the disease.

Vibrissea hypogæa has also been found at Ames on an old dead grape root.

White rust of beets.—Late in October, when the beets were being harvested, one of the students, Mr. W. Zmunt, brought a leaf of the common beet, which showed several white pustules which proved to be a *Cystopus*. A careful search through other herbaria has shown more specimens. I have not seen the oöspores, so I can not say to which species it belongs, but the conidia resemble those of *Cystopus bliti* (Biv.) de Bary. This has not been recorded as occurring on any of the Chenopodiaceæ in the United States. Frank,* Sorauer,† Berlese, and De Toni‡ record it as occurring on *Chenopodium*, a genus closely related to *Beta*. Here again we are confronted with the question why this *Cystopus* should affect the beet in Iowa and apparently has not been found on this host in other parts of the world. It certainly seems that if the fungus had occurred commonly it would have been observed before.

III.—FOREST TREES.

Thus far I have not observed *Glœosporium nervisequum* on sycamore trees in the vicinity of Ames, but a fungus giving the leaves of *Æsculus glabra* a similar scorched appearance was found early in August. It is due to the parasitic fungus *Phyllosticta sphæropsoidea*, E. and E. By the middle of September many of the leaves were dry and had fallen from the trees.

Cedar-apple fungus.—So far as I know the only recorded species for this locality is *Gymnosporangium macropus*, but last spring a second species, *G. globosum*, was found infesting one of the cedars. *G. macropus* is the common species in Illinois, Wisconsin, and Iowa, and I think is the common "cedar apple" in most parts of the United States. Dr. Halsted§ concluded that we have only one species in this locality. I found only a single specimen of the other after a diligent search. It might in this connection be interesting to state that some of the wild crab apples close to *Juniperus Virginiana* have been so severely attacked by *Rœstelia pyrata* that not only was every leaf affected but the fruit and young branches as well. The young branches usually died, so that the trees are in a bad condition. It was also noticed that before *Gymnosporangium macropus* appeared the leaves coming from the small lateral branches were yellow, as if they had been infested by the fungus. Other duties have prevented my studying these early yellow

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* Krankheiten der Pflanzen, p. 419.

† Pflanzenkrankheiten, Vol. II, p. 175.

‡ Saccardo Sylloge fungorum, Vol. VII, p. 236.

§ Halsted, Bull. Iowa Agric. College, Botanical Dept., 1886, p. 63. Report U. S. Dept. Agriculture, 1888, p. 370.

leaves carefully. Dr. Farlow* refers to *Ræstelia aurantiaca* as possibly being perennial.

Marsonia juglandis (Lib.) has been quite destructive to *Juglans cinerea* and *J. nigra*, causing brown spots to appear on the leaves. Trees thus affected lose their foliagepre maturely. *Marsonia Martinii* Sacc. and Ell., commonly occurred on *Quercus alba* and *Q. rubra*, causing pale colored spots with two-celled spores. *Phyllactinia suffulta* occurred destructively on *Fraxinus* at Ames the past summer.

REMARKS ON THE FUNGUS OF A POTATO SCAB.

(*Spongospora solani* Brunch.)

By Prof. G. DE LAGERHEIM.

In purchasing some potatoes at a market in Quito for use in bacterial cultures, I noticed while cleaning them that they were affected with black warts. An incision into these warts convinced me that they were caused by the fungus *Spongospora solani*, described by Brunchorst† several years ago. This disease is said not to occur in North America,‡ as the disease known as "scab" is there produced by other fungi. Since South America is the home of the potato, it seemed to me of interest to study this disease here. The disease is generally known in Quito, and manifests itself on potatoes from various localities. It is called "Cara,"§ and is supposed to be occasioned by the gnawing of worms.

The microscopic appearance and the behavior of the warts coincide fully with the description and illustration given by Brunchorst (loc. cit., p. 219, Plate I, Fig. 2). While the microscopic illustrations of Brunchorst were quite accurately drawn, they were, nevertheless, altogether erroneously interpreted. The wart-forming tissue, which he considers as a part of the potato altered by the disease, is the pseudo-parenchyma of fungus hyphæ, in which the characteristic spore balls arise. The fungus is, therefore, not a Myxomycete, and has no relation to Plasmodiophora. In cross sections of the warts hyphæ are often seen growing out of the pseudo-parenchyma, their membranes being precisely of the same color as the cells of the pseudo-parenchyma. The membranes of the hyphæ are of a more or less purple-brown color. In a wart that does not yet contain spores the hyphæ are filled with a colorless protoplasmic substance, which is very often full of vacuoles. It is perhaps

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* Farlow: The Gymnosporangia or Cedar Apples of the United States. Memoirs Boston Soc. Nat. Hist.

† Regarding a very widespread disease of the tubers (Bergens Museum, Aarsberetning, 1886) Bergen, 1887.

‡ According to Thaxter. Report of the Mycologist, p. 6 (Fourteenth Annual Report of the Connecticut Agricultural Experiment Station, 1890), New Haven, Connecticut.

§ A word from the Quichua language, which means scab in English, or *sarna* in Spanish.

this vacuolated protoplasm which Brunchorst (loc. cit., Plate I, Fig. 6) mistook for the plasmodia of his *Spongospora.* In the warts containing mature spore balls the hyphæ are usually empty. The structure of the spore balls was correctly understood and drawn by Brunchorst (loc. cit., p. 221, Plate I, Figs. 4, 5), but they are not detached, being fastened to the surrounding hyphæ of the pseudo-parenchyma. In thin cross sections one can easily see that this is so, and that very often, if not always, branches of the hyphæ penetrate the interstices of the spore ball, fill them up, and are firmly united to the individual spores. According to this the development of the spore balls is quite different from the one stated by Brunchorst (loc. cit., p. 223). I did not meet with any early stages of the spore formation among my material. According to the structure of the mature spore balls it is presumable, however, that they arise in the following way: Neighboring hyphæ develop upon the pseudo-parenchyma, and divide up into small cells which cling firmly to, and partly surround, the sporogenus hyphæ. The outer membrane of the peripheral spores is not quite smooth, but seems granulose. The size of the individual spores agrees with the statement made by Brunchorst. I have been as unsuccessful as Brunchorst in making the spore balls germinate. Until we understand their manner of germination it would be premature to assign the fungus to any definite place in the system of classification. Probably the liberation and germination of the spores results through the decay of the surrounding pseudo-parenchyma. Brunchorst mentions that the crusts are frequently eaten by insect larvæ, and this seems to be the case here also. It is probable that the spores pass through these insects without sustaining any injury, and are distributed in this manner. It might prove of interest to make experiments in this line.

In conclusion a few words may be said in regard to the correct name of the fungus. It seems to me that *Spongospora solani* Brunchorst is identical with a fungus long known and described by various authors. The name of this fungus is *Erysibe subterranea* Wallroth (Linnea, 1842, p. 332), which is said to have the following synonyms:

Protomyces tuberum-solani, Martius, Kartoffel Epid., 1842, p. 28, t. II, Figs. 9–13, t. III, Figs. 36–38.

Tubercinia scabies, Berkeley, Journ. Roy. Hort. Soc., 1846, vol. I, p. 33, Figs. 30, 31.

Sorosporium scabies, Fischer von Waldheim Aper. Syst. Ustil., 1877, p. 33.

Unfortunately the publications of Wallroth, Martius, and Berkeley are not accessible to me, which renders it impossible for me to decide this question. If my supposition be correct, the fungus should be called *Spongospora subterranea* (Wallr.).

MICROBIOLOGICAL LABORATORY AT QUITO, *June 24, 1891.*

DESCRIPTION OF TWO NEW SPECIES OF PERONOSPORA.

By M. B. Waite.

Peronospora celtidis.

(Plate XVII, Figs. 1-16.)

Spots definite, angular, minute, about 1^{mm} or less in diameter, limited by the veinlets; by confluence forming irregular patches or covering the greater part of the leaf; dark purple above, and when close together surrounded by an indistinct yellow border; on the under side at first dark green in color, with a water-soaked appearance, becoming ashy gray as the conidiophores are thrown up, then brownish, the confluent patches soon becoming brown.

Mycelial hyphæ small, delicate, much branched, from 3 to $7\frac{1}{2}\mu$ in diameter, averaging about 6μ, with very thin and hyaline cell walls. Haustoria not seen.

Conidiophores slender, four to five times branched and bearing from 14 to 28 conidia, branching in the so-called dichotomous manner, but with the first branch extending outward at nearly a right angle. Branches and tips nearly straight, tips gradually tapering to a blunt point. Total length of the conidiophores 200 to 320μ. Length of the stem to the first branch nearly equal to the length of the head from the first branch to the tip.

Conidia elliptical, nearly twice as long as broad, 14 by 26μ to 20 by 38μ, averaging about 16 by 31μ, provided with a blunt apiculus and a swelling at the base which closely resembles that at the apex, making the two ends appear alike, dark, smoky colored; germinating by zoöspores, eight or nine in number, which break through the apical papillus. In living specimens viewed with a low power of the microscope as an opaque object the conidia appear black, and the conidiophores are hygroscopic.

Oospores produced abundantly in the leaf parenchyma, to which the whole fungus seems to be limited; subglobose, light brown in color, 28 by 36μ to 30 by 44μ; endospore rather thin; exospore smooth, quite variable in thickness, causing the margin of the oöspore to appear undulate in cross section. Walls of the oögonium thin.

On *Celtis occidentalis*, L. Washington, D. C., October 7, 1891, Herb. M. B. Waite, No. 556; October 9, 1891, Herb. M. B. W., No. 557. Still Pond, Md., October 10, 1891, Herb. W. T. Swingle, Nos. 4026, 4027.

Observations:—This species is an exceptional form in many respects. It is the only species in the family so far found growing on a tree, although *Phytophthora omnivora* grows on seedlings of *Fagus* and other trees, and *Plasmopara viburni*, Peck, on *Viburnum; P. viticola*, on *Vitis; P. ribicola* on *Ribes*, *Peronospora sparsa* on *Rosa* and *P. rubi* on *Rubus* all grow on woody plants. The spots formed on the leaves are usually small and

would at first glance scarcely be thought to be the work of a Peronospora. The leaves of the host plant are harsh and firm in texture. Whether from adaptation to this peculiar host or from other causes this species seems to have developed on different lines from most Peronosporaceæ. It does not fit well into the present scheme of classification. The germination by zoöspores would suggest Plasmopara, but the long, dark-colored conidia are much unlike the typical conidia of that genus, which are small, orbicular, and hyaline. The conidia of this species are also remarkable for the papillus at the base. The conidiophores are similar to those of Peronospora, but the nearly straight branches and the tendency of the first branch to come out at nearly a right angle gives at least a suggestion of Plasmopara. It should be remarked that the so-called pinnate conidiophores of Plasmopara are not pinnate. The lateral branches are rather short and are arranged along a lengthened axis after the manner of the two-fifths phyllotaxy in phenerogams. In the dichotomous forms, as in Peronospora, the branches are arranged in the same way except that the lowest branch is relatively long and extends upward rather than straight out, but there is rarely any difficulty in deciding which is the main stem. They are not, then, truly dichotomous.

The conidiophores of *P. celtidis*, while of the type *Peronospora*, may be regarded as a step toward *Plasmopara*. So far as known to me no one has studied the exact arrangement of the branches of the conidiophores of any species of this order. Outline drawings are scarcely satisfactory representations of these objects, because they do not clearly indicate whether a given branch extends up or down from the plane of the drawing. The figures of the conidiophores given on Plate XVII are open to this objection. It is not easy to determine how each branch extends, much less to represent it accurately in a drawing.

The mycelium of this species looks quite unlike the typical mycelium of Peronospora. It is much more delicate and somewhat resembles that of the Uredineæ. The oöspore is apparently identical with that of the section *Effusæ*. The oöspores of the two species represented on the plate are strikingly similar except in size. But with all the characters taken into account one would scarcely wish to place *P. celtidis* in the section *Effusæ*. Mr. W. T. Swingle has pointed out to me that *Peronospora cubensis*, B. and C., resembles *P. celtidis* quite closely, and is its nearest ally, and that these two species form a group by themselves, differing considerably from either *Peronospora* or *Plasmopara*. Both have long, very dark conidia, pointed at each end and germinating by zoöspores, with conidiophores of the so-called dichotomous type, and strongly hygroscopic. For the present the form on Celtis is thought to be best placed in the genus *Peronospora*.

PERONOSPORA HYDROPHYLLI.

(Plate XVII, Figs. 17-24.)

Spots yellowish on both sides of the leaf, but more visible from above, to 4^{mm} broad by 10 to 25^{mm} long, with rather indistinct margins, limed laterally by the veins, or by confluence covering the greater part f the leaf, becoming brown with age or causing the whole leaf to shrivel p. Under surface of the spots sparsely frosted by the conidiophores.

Mycelial hyphæ occasionally branching, quite irregular, narrowed own at frequent intervals to half the average diameter and covered ith protuberances, some of which are sufficiently extended to form ranches; diameter varying from 6 to 7μ in the constricted portions to 5 or 16μ, or even more, in the swollen parts, averaging 10 to 12μ.

Haustoria small, 15 to 24μ long, consisting of a short, broadly clavte branch with three to five finger-like small branches arranged in a horl around its apex.

Conidiophores rather large, dichotomously many times branched, the ranches bent into reversed curves and often twisted around each ther; tips slender, tapering to a blunt point, curved or often with a eversed curve, numbering sixteen in a small specimen to fifty on an verage, or to seventy-five on a very large one. Total length of the onidiophore varying from 200 to 450μ, length of the stem to the first ranch varying from one-half to four-sevenths the total length. The first branch is relatively large, usually from two-thirds to three-fourths of the length of the whole head, and contains about that proportion of the tips, often nearly equaling the rest of the head.

Conidia ovate, without apical papillæ or marks to indicate the point of attachment; smoky colored, measuring 19 by 28μ to 25 by 35μ, averaging about 21 by 30μ; germinating by means of a lateral tube which is often curved in a loose spiral and usually at one or two points swollen abruptly to twice the normal size, which is gradually resumed again.

Oöspores produced in the leaf parenchyma, subglobose, 39 to 45μ in diameter, light brownish in color; endospore rather thick; epispore thin in places, causing the margin of the spore to become undulate in section. Walls of the oögonium thin.

On *Hydrophyllum Virginicum*, L. Oregon, Ill., June 1, 1888. Herb. M. B. Waite, No. 558. Near Washington, D. C., May 5, 1889, No. 559, a single infected plant. Iowa City, Iowa, spring, 1888. A. S. Hitchcock.*

Observations.—It will be seen from the description and drawings that this species is a typical *Peronospora* of the section *Effusæ*. It presents no difficulties in classification unless it be in the fact that the species in the section *Effusæ* are not very clearly defined, and botanists are obliged to depend mainly on the host plants for the determination of the species. The germination of the conidia was accomplished by

* These specimens are mentioned, but not described, by McBride and Hitchcock, in Bull. No. 1, from the Laboratories of Nat. Hist. of the State Univ. of Iowa, p. 51.

placing them in water on a glass slide, under a bell jar. The conidia used for the purpose were taken from fresh leaves which had been gathered in the tin collecting box and had remained there several hours. They were placed in water during the day, and on the following morning they had thrown out their germ tubes. These show one or more peculiar swellings or bulb-like expansions. This is not rare in the Peronosporaceæ, but has been observed in a number of species. De Bary figures * the germinating conidia of *P. effusa* and several other species showing this character.

There is often more than one conidiophore extending from a stoma. In some cases as many as five were seen. (Plate XVII, Fig. 19.) The manner in which the conidia originate from the mycelium is the same as in *Bremia lactucæ* as figured by Cornu.† A mycelial thread running near a stoma sends out a branch which is contracted at the point of emission, but soon swells out so as to nearly equal the parent branch. As it nears the opening of the stoma it narrows down to a small filament which passes through the opening between the guard cells and then swells out into the bulb-like base of the conidiophore.

Type specimens of both these species have been deposited in the herbarium of the Division of Vegetable Pathology, U. S. Department of Agriculture, and have been sent to the following herbaria: Philadelphia Academy of Science; Columbia College, New York; Harvard University, Cambridge, Mass.; Royal Herbarium, Kew, England; Museum of Natural History, Paris; Royal Botanic Garden, Berlin; Royal Botanic Garden, Rome; Museum of the Royal Botanic Garden, St. Petersburg, and to several individuals.

EXPLANATION OF PLATE XVII.

Figs. 1–16, *Peronospora celtidis*, n. sp.

Figs. 1, 2. Leaves of *Celtis occidentalis* showing spots caused by the Peronospora.

3. Typical conidiophore × 224. The branches do not all lie in one plane, as the figure might lead one to think, but are arranged around the stem like the branches of a tree. The lowest branch extends to the right and upward; the second branch extends to the left and also slightly upward.
4. Conidiophore below the average size, × 224.
5. Tips of the conidiophore more enlarged, × 640.
6. Young conidiophore with conidia attached, × 224.
7. Conidiophore nearly mature but with protoplasm still in the stem, × 224.
8. Conidium, with its contained zoöspores, just ready to burst.
9. Conidium discharging its zoöspores.

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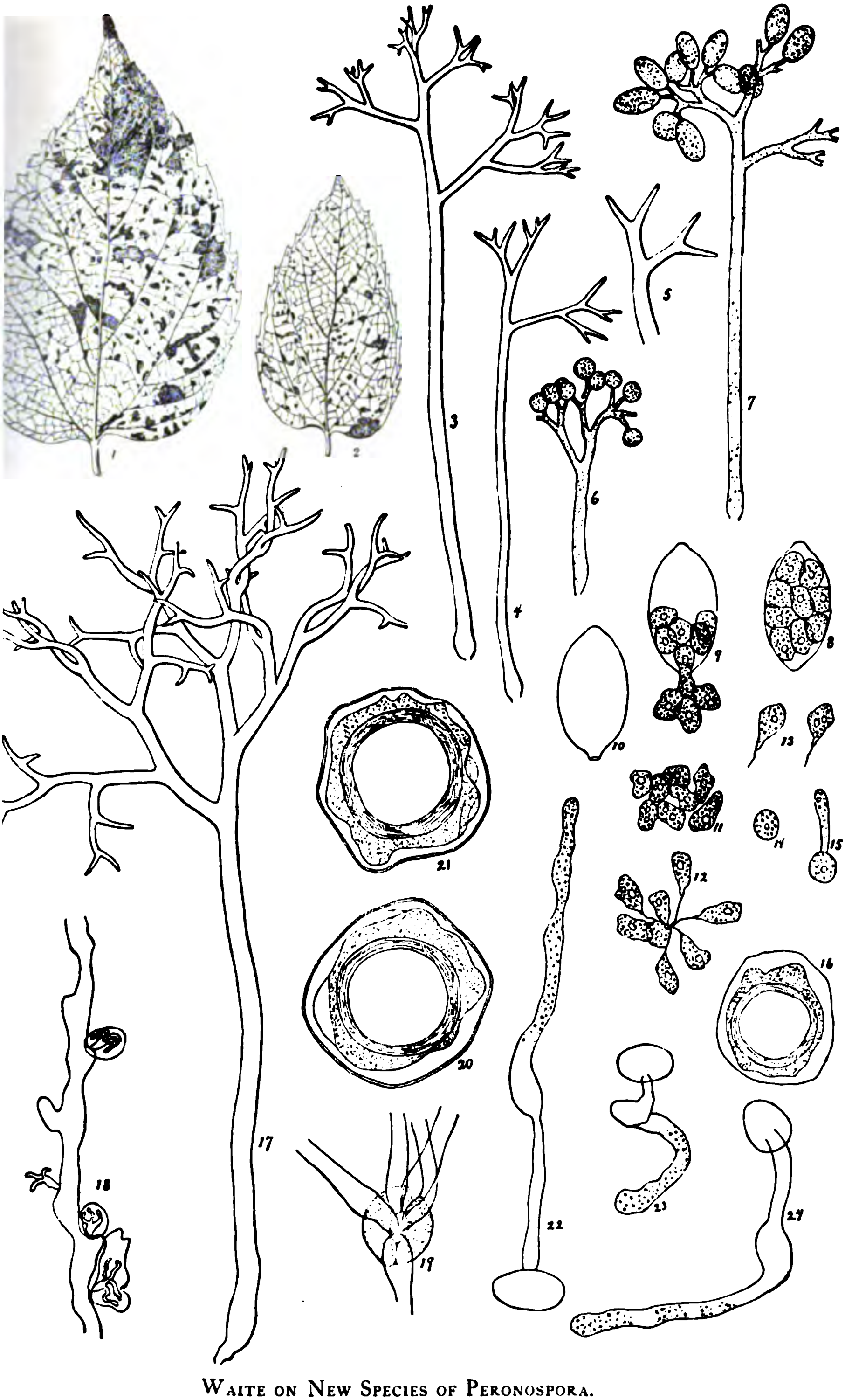
* Recherches sur le développment de quelques Champignons Parasites. Ann. Sci. Nat. Botanique, sér. 4° tome xx, Plate 8, Fig. 7.

† Institute de France. Académie des Sciences. Observations sur le Phylloxera et sur les Parasitaires de la Vigne, etc. Études sur les Péronosporées. I. Le Mennier, Maladie des Laitues, 1881.



WAITE ON NEW SPECIES OF PERONOSPORA.

Fig. 10. Empty conidium.
11. Mass of zoöspores just escaped and still fastened together.
12. The same breaking apart.
13. Zoöspore swimming free. One cilia represented. Two or three doubtfully observed.
14. Zoöspore rounded up and at rest.
15. Zoöspore germinating.
16. Oöspore in section, × 640.

Figs. 17–24, *Peronospora hydrophylli*, n. sp.

17. Conidiophore, average size, × 224.
18. Mycelium, with haustoria and cells of the host penetrated by them, × 224.
19. Stomate, with five conidiophores extending from it, × 224.
20, 21. Oöspores in section, × 640.
22–24. Germinating conidia.

SOME PERONOSPORACEÆ IN THE HERBARIUM OF THE DIVISION OF VEGETABLE PATHOLOGY.

By W. T. Swingle.

Finding a number of interesting species of Peronosporaceæ in the herbarium of the Division of Vegetable Pathology, I have decided to report on all specimens there represented that have not been mentioned previously. I have included a number of interesting forms collected during the past year, but have excluded all specimens in exsiccati as they are already known to most students of the group. I have included every collection, even of the most common species, because the record of date and locality may, even in such cases, prove of value in the future. Every specimen has been examined for oöspores and they have been reported whenever found. Nothing is mentioned in the paper that is not represented by a specimen in the herbarium.

ALBUGO (Persoon, §).

S. F. Gray. A natural arrangement of British plants, vol. 1, 1821 p. 540, No. v, p. 155.
1801. *Uredo* § *Albugo*, Persoon. Synopsis method. fungorum, p. 223.
1847. *Cystopus*, J. H. Léveillé, Sur la disposition méthodique des Urédinées. <Ann. des Sci. Nat., 3e sér., Botanique, tome 8, Paris, 1847, p. 371.

There seems to be no doubt that the generic name *Cystopus* must be abandoned in favor of *Albugo*, which has twenty-six years priority. There can be no question as to the identity of the two genera. Gray includes *Albugo* in the subfamily *Cœomideæ* which he describes thus:

Sporidia dust-like, free, heaped, sessile or pedicelled, one or many celled, growing at first under the epidermis of living plants, then bursting through it, naked or covered with a false peridium or thecæ formed of the epidermis of the plant on which it grows.*

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* Loc. cit., p. 532.

Ræstelia, *Æcidium*, *Ustilago*, *Uredo*, and *Albugo* are included in this subfamily. The genus is described as follows:

v. 155. *Albugo*, Persoon.—Sporidia globular, sessile, one-celled, inclosed in the bullated epidermis of live plants.—White.*

The species *Albugo cruciferarum*, Gray (*Albugo candida* (Pers.) O. Kuntze), *Albugo tragopogi* (Pers.) Gray, and *Albugo petroselini* (DC.) Gray, are included under *Albugo*. Thus not only is the genus unmistakably characterized in the description, but all the species included, excepting possibly *A. petroseleni*, are still retained in the genus. Otto Kuntze in his "Revisio generum plantarum," issued in 1891, has restored *Albugo*. I may say that I had already decided that the change was necessary. It is a fortunate accident that the older name proves to be one so well adapted. It was long used as a subgeneric name for white rusts. Berkeley, writing in 1848, says:

Dr. Léveillé has described the genus under the name of *Cystopus* with very correct characters. It is to be wished, however, that he had adopted Schweinitz and Rabenhorst's sectional name of *Albugo* (Rab. Crypt. Fl., vol. 1, p. 13), which is far more expressive; and as a general principle sectional names ought certainly to be adopted when the sections are raised to the rank of genera.†

1. **Albugo candidus** (Persoon) O. Kuntze. Revisio generum plantarum, Pars II, 1891, p. 658, footnote 1.

1791. *Æcidium candida*, Persoon. <Gmelin, Caroli a Linné Systema nat., ed. 13, tome 2, pars 2, 1791, p. 1473.

1847. *Cystopus candidus* (Persoon), Lévéille. Sur la dispos. méthod. des Urédinées. <Ann. Sci. Nat., 3e sér., t. 8, 1847, p. 371.

Conidia on leaves, stems, and inflorescences, oöspores in stems and inflorescences of Cruciferæ.

On *Cardamine ludoviciana*, Meyer. S. M. Tracy, March 21, 1888, Starkville, Oktibbeha County, Miss. Conidia only, on radical leaves.

On *Dentaria diphylla*, L. L. M. Underwood. May, 1889, Dryden, Tompkins County, N. Y. Conidia and immature oöspores on leaves.

On *Sisymbrium canescens*, Nutt. F. D. Kelsey, April, 1888, Billings, Yellowstone County, Mont. Conidia only, on cauline leaves. F. D. Kelsey, No. 15, June, 1888, Helena, Lewis and Clarke County, Mont. Conidia only, on cauline leaves.

On *Sisymbrium linifolium*, Nutt. F. W. Anderson, No. 9, May 17, 1887, Helena, Lewis and Clarke County, Mont. Conidia only, on stems and cauline leaves.

On *Brassica alba*, L. E. M. Fisher, No. 88, August, 1890, Urmeyville, Johnson County, Ind. Conidia only, on cauline leaves.

On *Brassica nigra*, Koch. T. A. Williams, No. 274a, June, 1890, Weeping Water, Cass County, Nebr. Conidia only, on leaves. E. M.

* Loc. cit., p. 540.

† Berkeley, M. J. On the White Rust of Cabbages. <Jour. Hort. Soc., London, vol. 3, London, 1848, pp. 269–270 (p. 8 of reprint).

Fisher, No. 72, July 22, 1890, Urmeyville, Johnson County, Ind. Conidia only, on cauline leaves.

On *Nasturtium sessiliflorum*, Nutt. S. M. Tracy, July 11, 1887, Wadsworth, Washoe County, Nev. Conidia only, on leaves, stems, and capsules.

On *Nasturtium armoracia*, Fries. B. T. Galloway, May, 1887, Boone County, Mo. Conidia only, on stems, flowers, and on radical and cauline leaves.

On *Capsella Bursa-pastoris*, Moench. W. T. Swingle, No. 4000, May 2, 1891, Alexandria, Alexandria County, Va. Conidia only, on leaves, stems, and inflorescences; oöspores, immature in stems. W. T. Swingle, No. 4002, May 22, 1891, Norfolk, Norfolk County, Va. Conidia on capsules; oöspores mature, abundant, in stems and infloresences. B. T. Galloway, June 13, 1888, Washington, D. C. Conidia on leaves and stems; oöspores immature in stems. M. B. Waite, No. 333, November 17, 1888, Department Agriculture grounds, Washington, D. C. Conidia only, on radical leaves.

On *Lepidium Virginicum*, L. M. B. Waite, No. 259, May 13, 1888, Oregon, Ogle County, Ill. Conidia only, on cauline leaves.

On *Lepidium* (sp. ?) H. W. Ravenel, No. 291b, 1869, Houston, Harris County, Tex. Conidia only, on leaves. T. A. Williams, No. 274[b], June, 1890, Weeping Water, Cass County, Nebr. Conidia only, on radical leaves.

On *Lepidium campestre*, Br. W. T. Swingle, No. 4003, May 31, 1891, low ground by monument, Washington, D. C. Conidia and mature oöspores in stems.

On *Raphanus sativus*, L. E. M. Fisher, No. 83, July 25, 1890, Urmeyville, Johnson County, Ind. Conidia only, on both sides of radical leaves. E. M. Fisher, No. 83, August, 1890, Urmeyville, Johnson County, Ind. Conidia and oöspores in enormously distorted flowers.

2. **Albugo portulacæ** (De Candolle) O. Kuntze, loc. cit., 1891, pars. II, p. 568.

1815. *Uredo portulacæ*, De Candolle. <Lamarck et De Candolle, Fl. française, t. v ou vol. VI, p. 88, No. 637.

On leaves of Portulacaceæ.

On *Portulaca oleracea*, L. T. A. Williams, No. 255, June 18, 1890, Weeping Water, Cass County, Nebr. Conidia and mature oöspores in leaves. S. M. Tracy, July 10, 1888, Starkville, Oktibbeha County, Miss. Conidia and mature oöspore in leaves. M. B. Waite, No. 127, August 8, 1885, Oregon, Ogle County, Ill. Conidia only. E. M. Fisher, No. 163, August, 1890, Urmeyville, Johnson County, Ind. Conidia only. M. B. Waite, (Herb. Div. Veg. Path. No. 377), September 19, 1889, Champaign, Champaign County, Ill. Conidia and mature oöspores in leaves. G. W. Clinton, 18—, Buffalo, Erie County, N. Y. Conidia only.

3. Albugo tragopogonis (Persoon) S. F. Gray, Nat. Arrang. Brit. Plants, vol. I, 1821, p. 540.

1801. *Uredo* (*Albugo*) *candidus* Pers. *β. Uredo Tragopogonis*, Persoon. Syn. meth. fung. I, p. 223, No. 348.

1886. *Cystopus Tragopogonis* (Persoon) Schroeter. Die Pilze Schlesiens, Hälfte I, p. 234.

On leaves of Compositæ.

On *Helianthus* (sp. ?). C. A. Hart, July 12, 1883, Quincy, Adams County, Ill. Conidia and mature oöspores in leaves. C. A. Hart, July 17, 188–, West Quincy, Adams County, Ill. Conidia and mature oöspores in leaves. I am inclined to think the host is *Iva ciliata*, but can not be certain. As far as I know *A. tragopogonis* is unknown on *Helianthus*, although it is abundant in some places on *Iva ciliata*.

On *Franseria discolor* Nutt. (?). S. M. Tracy, September 10, 1887, Denver, Arapahoe County, Colo. Conidia on stems and leaves, oöspores mature, in leaves.

On *Ambrosia artemisiæfolia*, L. A. B. Seymour, August 12, 1885, Granville, Hampden County, Mass. Conidia and mature oöspores on leaves.

On *Ambrosia* (sp. ?). S. M. Tracy, June 21, 188–, Coolidge, Bernalillo County, N. Mex. Conidia only, on leaves.

On *Artemisia biennis*, Willd. B. D. Halsted, 1885, Spirit Lake, Dickinson County, Iowa. Conidia only, on leaves.

On *Senecio serra*, Hook., var. *integriusculus*, Gr. F. D. Kelsey, July 9, 1888, Helena, Lewis and Clarke County, Mont. Conidia and mature oöspores in leaves.

On *Cnicus horridulus*, Pursh. W. T. Swingle, No. 4004, May 22, 1891, Norfolk, Norfolk County, Va. Conidia and mature oöspores in leaves.

On *Cnicus lanceolatus*, Hoffm. G. W. Clinton, 18—, Buffalo, Erie County, N. Y. Conidia only, on leaves.

On *Tragopogon pratensis*, L. W. A. Kellenman, No. 10[b], July 15, 1880, Göttingen, Germany. Conidia only, on leaves.

On *Tragopogon porrifolius*, L. G. W. Clinton, 18—, Buffalo, Erie County, N. Y. Conidia only, on leaves.

4. Albugo ipomœæ-panduranæ (Schweinitz) Swingle.

1822. *Aecidium Ipomoeae-panduranae*, Schweinitz. Synopsis fung. Carol. No. 454. <Schriften der naturforschenden Gesells. zu Leipzig, Bd. I, p. 69.

1889. *Cystopus ipomoeae-panduranae* (Schw.) Stevs. & Swingle. List of Kansas species of Peronosporaceae, No. 2. <Trans. 20th and 21st meetings Kan. Acad. Sci., vol. XI, p. 67.

Conidia on leaves and stems, oöspores in stems and petioles of Convolvulaceæ.

On *Convolvulus?* (sp. ?). Conidia only, on leaves. W. T. Swingle, No. 4005, July 8, 1891, Eldorado, Lake County, Fla. Conidia only, on leaves. W. T. Swingle, No. 4006, July 13, 1891, Eldorado, Lake County, Fla. Conidia only, on leaves.

On *Ipomœa Batatas*, Lam. D. G. Fairchild, September 17, 1889, Vineland, Cumberland County, N. J. Conidia only, on leaves.

On *Ipomœa commutata*, R. and S. W. T. Swingle, No. 4007, June 15, 1891, Griffin, Spalding County, Ga. Conidia only, on leaves, stems, and peduncles. A. B. Langlois, No. 602, August 6, 1886, Pointe à la Hache, Plaquemine Parish, La. Conidia only, on leaves.

On *Ipomœa hederacea*, Jacq. Erwin F. Smith, July 9, 1890, Talbot County, Ga. Conidia only, on leaves. A. B. Langlois, No. 598, July 27, 1886, Pointe à la Hache, Plaquemines Parish, La. Conidia only, on leaves.

On *Ipomœa incarnata*, Vahl. C. S. Sheldon, No. 230, July 28, 1891, Quanah. Indian Territory, com., J. M. Holzinger. Conidia only, on leaves and stems. Mr. J. M. Holzinger kindly called my attention to this new host for the species. Only two plants were sent by Mr. Sheldon, and both showed the unusually large sori on the stems and on nearly all the leaves.

On *Ipomœa leptophylla*, Torr. E. Bartholomew, No. 433, July 20, 1891, Rockport, Rooks County, Kans. Conidia on swollen stems and leaves, immature oöspores in swollen stems.

On *Ipomœa pandurata*, Meyer. S. M. Tracy, July 1, 1888, Starkville, Oktibbeha County, Miss. Conidia only, on leaves. M. B. Waite, No. 258, September 10, 1888, Oregon, Ogle County, Ill. Oöspores only, in swellings on stems and leaves. The leaves often show a number of spots 5–20 mm. in diameter that are bulged and corrugated and literally filled with nearly mature oöspores. Possibly the leaf spots would have shown some conidia earlier in the season. E. M. Fisher, No. 201, September, 1890, Urmeyville, Johnson County, Ind. Conidia and nearly or quite mature oöspores in bullated corrugated spots on the leaf. Much like Waite's, No. 258.

On *Ipomœa lacunosa*, L. L. F. Ward, Sept. 7, 1879, Alexandria County, Virginia. Conidia only, on leaves.

On *Ipomœa* (sp?). S. M. Tracy, September 13, 1888, Durant, Holmes County, Miss.

5. **Albugo platensis** (Spegazzini) Swingle.

1883. *Cystopus amarantacearum*, Zalewski. Zur Kennt. der Gatt. Cystopus Lév. Vorläufige Mittheilung. <Bot. Centralb., iv Jahrg. 1883, iii quartal Bd. xv, p. 223, pro parte.

1891. *Cystopus platensis*, Spegazzini. Phycomyceteae Argentinae, No. 15. <Revista Argentina de Historia Natural, tomo I, entrega 1ª, Buenos Aires, Feb. 1.°, 1891, p. 32.

Conidia on upper surface of leaves of Nyctaginaceæ. No oöspores found.

On *Allionia incarnata* L. S. M. Tracy, June 18, 1887, dry hills, 1 mile east of Albuquerque, Bernalillo County, N. Mex. Bilimek, No. 167, Sept. 21, 1869, Chapultepek, Mexico, Ex. Herb. Bot. Div. Dept. Agric. From Herb. Mus. Paris.

On *Boerhaavia diffusa*, (?) L. Newberry in McComb's expedition, sandy river bottoms, 1859, N. Mex., Colo., or Utah. Ex. Herb. Bot. Div. Dept. Agric.

On *Boerhaavia erecta*, L. Schott, No. 478, June 12, 1865, Merida, Yucatan, Mexico. Ex. Herb. Div. Bot. Dept. Agric. Edward Palmer, 1885, S. W. Chihuahua, Mexico. Ex. Herb. Bot. Div. Dept. Agric. Edw.

Palmer, No. 680, 1887, Los Angeles Bay, Guaymas, Mexico. Ex. Herb. Bot. Div. Dept. Agric. J. H. Simpson, July 11, 1890, Sarasota Bay, Manatee County, Fla. Ex. Herb. Bot. Div. Dept. Agric. W. T. Swingle, No. 4008, July 4, 1891, Eldorado, Lake County, Fla. W. T. Swingle, No. 4009, July 13, 1891, common on sandy land along railroad, Eldorado, Lake County, Fla.

On *Boerhaavia hirsuta*, Willd. Schott, No. 21, Feb. 12, 1865, Merida, Yucatan, Mexico. Ex. Herb. Bot. Div. Dept. Agric. W. T. Swingle, No. 4010, July 13, 1891, Eldorado, Lake County, Fla. The host may not be this species, as it was too young for positive determination.

On *Boerhaavia Sonoræ*, Rose. Edw. Palmer, September 16–30, 1890, Alamos de Calorce, Mexico. Ex. Herb. Bot. Div. Dept. Agric.

On *Boerhaavia spicata*, Choisy. Geo. Vasey, 1881, Las Cruces, N. Mex. Ex. Herb. Bot. Div. Dept. Agric.

On *Boerhaavia viscosa*, Lag. et Rodr. Reverchon, No. 791, June, 1880, Dallas, Dallas County, Tex. Ed. Palmer, No. 212, Aug. to Nov., 1885, S. W. Chihauhua, Mex.

On *Boerhaavia Xanthii*, Watson. Edw. Palmer, No. 681, 1887, Guaymas, Sonora, Mexico. Ex. Herb. Bot. Div. Dept. Agric.

I found this interesting *Albugo* in Florida during the summer of 1891, and upon my return to Washington examined the specimens of Nyctaginaceæ in the herbarium of the botanical division of the Department of Agriculture, through the kindness of Dr. George Vasey and Mr. J. N. Rose. I was agreeably surprised to find many specimens here, as may be seen from the foregoing list. I am much in doubt as to the identification of the material, and would not publish this notice if it were not largely with the hope that it may call forth further observations and perhaps result in the finding of oöspores.

The first mention I have found of *Albugo* occurring on nyctaginaceous plants is by Zalewski,* in 1883, who reports an *Albugo* on Boerhaavia from Ceylon and from La Plata which he refers to his *Cystopus amarantacearum* (=*Albugo amaranthi* (Schw.) O. Kze.), on the strength of the conidial characters, since he was unable to find oöspores. In speaking of this form he says: "die Conidien sind aber hier von denen von C. Amarantacearum gar nicht zu unterscheiden." I find, however, that the specimens reported above (also lacking oöspores) seem to differ constantly from *Albugo amaranthi* in several points. First, the conidia are in every case yellowish as seen in mass, being almost exactly of the color of those of *A. portulacæ* and unlike those of *A. amaranthi*, which are white. Second, the terminal conidium shows in every case a very much thicker internal equatorial band which is dusky or even brown in color, while a similar structure in *A. amaranthi* is colorless or nearly so. Very possibly further differences will be found to exist, since I have not had time to make an exhaustive examination of the two species. These constant differences, together with the failure to find oöspores in

* Zur Kennt. der Gatt. Cystopus Lév. Vorläufige Mitt. in Bot. Centralb., loc. cit., pp. 222–223.

all specimens studied and the fact that the fungus is parasitic on a different, although related, family of plants, make me hesitate to refer it to *A. amaranthi*.

In 1880 Spegazzini* included in *Cystopus cubicus* (=*Albugo tragopogonis* (Pers), O. Kze.), a form occurring on leaves of *Boerhaavia erecta* found at Barracas del Sur, Argentine. Our species, however, appears to differ from *A. tragopogonis* in at least the following ways: First, in having spores yellowish in mass; second, in having the terminal conidia smaller than the others; and, third, in the conidia having a dusky-brown equatorial band. Besides this the families of the host plants are not at all closely related, and from this fact alone it is probable that the species are distinct.

The next reference I find to an Albugo on Nyctaginaceæ is by Spegazzini,† who, in 1891, described a new species, *Cystopus platensis*, on Boerhaavia from Argentine. As his description may not be accessible to all interested, I quote in full:

> 15. Cystopus platensis Speg. (n. sp.)–Fung., Arg. pug. I, n. 68 (sub *C. cubico*).
>
> *Hab.* In foliis vivis *Boerhaviae hirsutae* prope Buenos Aires (1880), et prope Córdoba (1887).
>
> *Obs.* Sori hypophylli macula primo pallescente dein purpurascente cincti, irregulares minuti (1–2 mllm. diam.) sparsi v. hinc inde laxe gregarii, vix prominuli candidi diu epidermide velati, dein erumpentes ac pulverulenti; conidia globoso-cuboidea ($20–22 \times 18–20\mu$) hyalina catenulata, minute densissimeque punctulata (an tantum granuloso farcta?), suprema ovata obtusa; cellulae basales steriles obconico-turbinatae ($40–45 \times 12–15\mu$) crasse tunicatae per aetatem flavescentes. Oosporae ignotae. Species praecedenti [*C. bliti* on Amaranthaceæ] peraffinis sed conidiis punctulatis majoribus satis, ut videtur, recedens.

The conidia of the preceding species are given as $16–18 \times 15–17\mu$.

6. **Albugo amaranthi** (Schweinitz) O. Kuntze. Rev. gen. Pl. I, vol. II. p. 658, footn. 1.

1834. *Caeoma* [§ *Uredo* (*Albugo*)] *Amaranthi*, Schw. Syn. fung. Am. Bor., No. 2853. <Trans. Am. Phil. Soc., Phila., new ser., vol. IV, p. 292.

1874. *Cystopus Amaranthi* (Schw.) Berkeley. Notices of N. Am. Fungi, No. 571. <Grevillea, vol. III, London, No. 26, December, 1874, p. 58.

Conidia and oöspores in leaves of Amarantaceæ.

On *Amarantus chlorostachys*, Willd. W. T. Swingle, No. 4011, June 26, 1891, Baldwin, Duval County, Fla. Conidia only, on leaves.

On *Amarantus chlorostachys*, var. *hybridus*. Wats. E. M. Fisher, No. 84, July 25, 1890, Urmeyville, Johnson County, Ind. Conidia and mature oöspores in leaves. E. M. Fisher, No. 84, August, 1890, Urmeyville, Johnson County, Ind. Conidia and mature oöspores in leaves.

On *Amarantus crispus*, Braun. S. M. Tracy, May 26, 1888, Starkville, Oktibbeha County, Miss. Conidia and mature oöspores in leaves.

On *Amarantus spinosus*, L. W. T. Swingle, No. 4012, June 26, 1891, Baldwin, Duval County, Fla. Conidia and mature oöspores in leaves.

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* Spegazzini, Fungi Argentini. Pugillus primus, No. 67. <Ann. Soc. Cientifica Argentina, tomo IX, Abril de 1880, Buenos Aires, p. 177.

† Spegazzini, Dr. Carolus. Phycomyceteae Argentinæ. <Revista Argentina de Hist. Nat., t. I, Buenos Aires, Feb. 1, 1891 p. 32.

On *Amarantus retroflexus*, L. E. M. Fisher, No. 37, July 18, 1890, Urmeyville, Johnson County, Ind. Conidia only, on leaves. C. A. Hart, August 2, 1883, Quincy, Adams County, Ill. Conidia and mature oöspores in leaves. E. M. Fisher. No. 37, August, 1890, Urmeyville, Johnson County, Ind. Conidia only, on leaves. M. B. Waite, No. 124, August 8, 1885, Oregon, Ogle County, Ill. Conidia and mature oöspores in leaves. E. Bartholomew, No. 88, August 10, 1888, Rockport, Rooks County, Kans. Conidia and mature oöspores in leaves. J. J. Davis, September 3, 1887, Racine, Racine County, Wis. Conidia only, on leaves. M. B. Waite, (Herb. Div. Veg. Path. No. 45), September 5, 1889, Lansing, Ingham County, Mich. Conidia and mature oöspores in leaves.

On *Amarantus* (sp. ?). G. W. Clinton, 18—, Buffalo, Erie County, N. Y. Conidia and oöspores in leaves. T. A. Williams, No. 324, July 15, 1890, Ashland, Saunders County, Nebr. Conidia and mature oöspores in leaves.

7. Phytophthora infestans (Montaigne) De Bary. Research into Nature of Potato Fungus. <Jour. Roy. Agric Soc., 2d ser., vol. XII, London, 1876, pp. 239–269.

1845. *Botrytis infestans*, Montaigne. <Jour. l'Inst., 1845, p. 313; also <Bull. Soc. Philomath. de Paris. Séance du 30 Août, 1845.

On leaves of Solanaceæ.

On *Solanum tuberosum*, L. A. B. Seymour (No. 5623, Herb. Ill. State Lab. Nat. Hist.), August 7, 1882, Camp Point, Adams County, Ill. E. A. Southworth, September 15, 1891, Smiths Mills, Chautauqua County, N. Y. W. T. Swingle, No. 4013, September 20, 1891, Garrett Park, Montgomery County, Md. This fungus was quite abundant in a field at this place and seriously injured at least the tops of the plants.

8. Sclerospora graminicola (Saccardo) Schroeter. Die Pilze Schlesiens I, 1886, p. 236, No. 352.

1876. *Protomyces graminicola*, Saccardo. Fungi veneti novi vel critici ser. VI, No. 91, <Nuovo giorn. bot. ital., vol. VIII, 1876, p. 172.

On leaves and inflorescences of Gramineæ.

On *Setaria viridis*, Beauv? Tom A. Williams, No. 257, August, 1889, Weeping Water, Cass County, Nebr. Conidia (?) and oöspores in leaves and in the distorted spikelets.

9. Plasmopara pygmæa (Unger) Schroeter. Die Pilze Schlesiens, I, 1886, No. 359, p. 239.

1833. *Botrytis pygmaea* Unger. Die Exanthemen der Pflanzen, pp. 172–173.

On leaves of Ranunculaceæ. Conidiophores hypophyllous on radical leaves.

On *Anemone Pennsylvanica*, L. C. A. Hart, May, 1884, Normal, McLean County, Ill.

On *Hepatica acutiloba*, DC. J. J. Davis, May 13, 1887, Racine, Racine County, Wis.

10. Plasmopara geranii (Peck). Berl. & De Toni. <Sacc. Sylloge fungorum, vol. VII, Part I, 1888, p. 242, No. 811.

1879. *Peronospora Geranii*, Peck. Rept. Botanist, in 28th Rept. N. Y. State Mus. Nat. Hist., p. 63.

On leaves of Geraniaceæ. Conidiophores always hypophyllous.

On *Geranium Carolinianum*, L. S. M. Tracy, March 11, 1888, Starkville, Oktibbeha County, Miss. M. B. Waite, No. 553, March 17, 1889, High Island, Montgomery County, Md. M. B. Waite, No. 555, April 10, 1889, High Island, Montgomery County, Md. F. S. Earle, April 28, 1883, Anna, Union County, Ill. Erwin F. Smith, May 11, 1889, dry fields, Still Pond, Kent County, Md. B. T. Galloway, May 17, 1891, Garrett Park, Montgomery County, Md. D. G. Fairchild, May 21, 1889, New Brunswick, Middlesex County, N. J. W. T. Swingle, No. 4014, May 22, 1891, Norfolk, Norfolk County, Va. B. T. Galloway, May 23, 1877, Boone County, Mo.

On *Geranium maculatum*, L. B. T. Galloway, July 4, 1888, Washington, D. C. With a few nearly mature oöspores in leaves.

11. **Plasmopara obducens**, Schroeter. Die Pilze Schlesiens, I, p. 238, 1886, No. 356.

1877. *Peronospora obducens*, Schroeter. <Hedwigia Bd. XVI, 1877, No. 9, p. 129–135.

On leaves and cotyledons of Geraniaceæ. Conidiophores hypophyllous.

On *Impatiens fulva*, Nutt. E. M. Fisher, No. 55, July 22, 1890, Needham, Johnson County, Ind. With very immature oöspores in leaves.

On *Impatiens* (sp.?). (*I. fulva* or *I. pallida.*) M. B. Waite, No. 551, April 10, 1889, Rosslyn, Alexandria County, Va. B. T. Galloway, May 3, 1891, Garrett Park, Montgomery County, Md. C. A. Hart, May 10, 1884, Bloomington, McLean County, Ill. J. J. Davis, May 15, 1887, Racine, Racine County, Wis. P. H. Dorsett, May 21, 1891, Benning's Station, Md.

12. **Plasmopara viticola** (Berkeley & Curtis) Berl. & De Toni. <Saccardo, Sylloge fungorum, vol. VII, Part I, p. 239. No. 806. 1888.

1860. *Botrytis viticola*, Berk. & Curt. <Ravenel Fungi Caroliniani Exsiccati. Fungi of Carolina, illustrated by natural specimens of the species, by H. W. Ravenal, Charleston. Cent. V., No. 90.

On leaves of Vitaceæ.

On *Vitis aestivalis*, Michx. M. B. Waite, No. 123, August 3, 1885, Oregon, Ogle County, Ill. M. B. Waite, No. 182, September 10, 1889., Oregon, Ogle County, Ill. M. B. Waite, No. 544, September 15, 1888, Oregon, Ogle County, Ill. W. T. Swingle, No. 4015, October 10, 1891, Still Pond, Kent County, Md.

On *Vitis cinerea*, Engelm. (?) E. M. Fisher, No. 89, July 18, 1890, Urmeyville, Johnson County, Ind.

On *Vitis cordifolia*, Michx. C. A. Hart, July 18, 1883, La Grange, Lewis County, Mo. E. M. Fisher, No. 89, July 26, 1890, Urmeyville, Johnson County, Indiana. Herman Jaeger, August 20, 1888, Neosho, Newton County, Mo. F. S. Earle and M. B. Waite, September 19, 1885, Urbana, Champaign County, Ill. W. T. Swingle, No. 4016, October 10, 1891, Still Pond, Kent County, Md.

On *Vitis* (cultivated, hort. var. Concord). M. B. Waite, No. 273, July

23, 1888, Champaign, Champaign County, Ill. M. B. Waite, No. 545, September 25, 1888, Urbana, Champaign County, Ill.

On *Vitis* (cultivated, hort. var. Clinton). S. M. Tracy, August 23. 1887, Plattville, Grant County, Wis.

On *Vitis* (cultivated, hort. var. Niagara). H. L. Rogers, July 17, 1890, Highland, Ulster County, N. Y.

On *Vitis* (cultivated, var. unknown). B. T. Galloway, September, 1888, Dept. Agric. Grounds, Washington, D. C. M. B. Waite (Herb. Div. Veg. Path., No. 359), September 18, 1889, Champaign, Champaign County, Ill. E. M. Fisher, No. 186, September, 1890, Franklin County, Ind. With mature oöspores in leaves. W. T. Swingle, No. 4017, October 10, 1891, Still Pond, Kent County, Md. I am not certain this was a cultivated grape, as it grew by the roadside, but it seemed unlike any wild grape I know.

13. **Plasmopara australis** (Spegazzini) Swingle. A list of the Kansas species of Peronosporacae No. 9. <Trans. Twentieth and Twenty-first Meeting Kans. Acad. Sci., vol. XI, 1889, p. 72.

1881. *Peronospora australis* Spegazzini. Fungi Argentini, Pugillus I, No.—. <Anales d. l. sociedad cientifica argentina, t. XII, 1881, p. 81.

On leaves of Cucurbitaceæ. Conidiophores always hypophyllous on cauline leaves.

On *Sicyos angulatus*, L. B. T. Galloway, June, 1887, Boone County, Mo. B. T. Galloway, July 25, 1886, Boone County, Mo. E. M. Fisher, No. 171, September, 1890, Needham, Johnson County, Ind.

14. **Plasmopara viburni** Peck. Ann. Rep. State Botanist of New York, p. 28. Reprint from 43d Rept. N. Y. State Mus. Nat. Hist., Albany, 1890.

On leaves of Caprifoliaceæ. Conidiophores hypophyllous on cauline leaves.

On *Viburnum acerifolium*, L. M. B. Waite, No. 535, October 11, 1891, Cascade Run, Washington, D. C.

On *Viburnum opulus*, L. D. G. Fairchild, September 28, 1889, Breese Hill, Md. D. G. Fairchild, October, 1889, Breese Hill, Md.

15. **Plasmopara entospora** (Roze and Cornu). Berl. and DeToni. <Saccardo Sylloge fungorum, vol. VII, Part I, p. 239, No. 805.

1867. *Basidiophora entospora* Roze and Cornu. Sur deux nouv. types d. Saproleg. <Ann. d. Sci. Nat. 5e sér. Bot., t. XI, 1869, pp. 84–89 (pp. 13–18 of reprint), Pl. 4.

On leaves of Compositæ, tribe Asteroideæ. Conidiophores hypophyllous on both radical and cauline leaves.

On *Aster Novæ-Angliæ*, L. W. T. Swingle, No. 4018, October 29, 1891, Garrett Park, Montgomery County, Md. Conidiophores on cauline leaves. Abundant.

On *Erigeron Canadense*, L. M. B. Waite, No. 121, May 13, 1885, Urbana, Champaign County, Ill. Conidiophores and abundant mature oöspores on cauline leaves.

16. **Plasmopara Halstedii** (Farl.) Berl. and DeToni. <Sacc. Syll. Fung., vol. VII, Part I, p. 242, No. 810.

1878. *Peronospora Halstedii*, Farlow. Notes on some species in the Third and Eleventh Centuries of Ellis's N. Am. Fungi. <Proc. Am. Acad. Arts and Sci., vol. V, new series, vol. X, 1878, p. 72.

On leaves of Compositæ. Conidiophores hypophyllous on cauline leaves.

On *Erigeron Philadelphicum*, L. (?). B. T. Galloway, September 25, 1891, Garrett Park, Montgomery County, Md.

On *Erigeron* (sp. ?). E. W. D. Holway, July 20, 1884, Decorah, Winneshiek County, Iowa.

On *Silphium perfoliatum*, L. M. B. Waite, No. 265, September 8, 1888, Oregon, Ogle County, Ill. S. M. Tracy, September 1, 1888, Plattville, Grant County, Wis. With mature oöspores on cauline leaves.

On *Ambrosia artemisiæfolia*, L. W. T. Swingle, No. 4019, September 20, 1891, Garrett Park, Montgomery County, Md.

On *Ambrosia trifida*, L. E. A. Southworth, May 1, 1891, College Station, Prince George's County, Md. B. T. Galloway, May 13, 1888, Virginia. C. G. Hart, May 14, 1884, Normal, McLean County, Ill. P. H. Dorsett, May 16, 1891, Benning's Station, Md. M. B. Waite, No. 266, May 19, 1888, Urbana, Champaign County, Ill. M. B. Waite, No. 541, June 1, 1888, Oregon, Ogle County, Ill. C. A. Hart, July 18, 1883, La Grange, Lewis County, Mo. T. A. Williams, No. 256, August 1, 1889, Wabash County, Nebr.

On *Helianthus grosse-serratus*, Martens. M. B. Waite, No. 546, May 28, 1888, Oregon, Ogle County, Ill. Conidiophores forming a dense white coating.

On *Helianthus* (sp. ?). C. A. Hart, May, 1884, Normal, McLean County, Ill. Conidiophores attacking only the basal portion and there forming a dense white coating. M. B. Waite (Herb. Div. Veg. Path., No. 318) September 4, 1891, Oregon, Ogle County, Ill. Conidiophores on cauline leaves in rather scattered spots. F. L. Scribner, July 17, 1887, Lanier Heights, Washington, D. C. Conidiophores forming a very dense white coating on the basal portion of the diseased leaves.

On *Bidens connata*, Muhl. E. M. Fisher, No. 188, September, 1890, Urmeyville, Johnson County, Ind.

On *Bidens frondosa*, L. E. M. Fisher, No. 58, July 20, 1890, Urmeyville, Johnson County, Ind. E. M. Fisher, No. 59, August, 1890, Urmeyville, Johnson County, Ind.

On *Erechthites hieracifolia*, Raf. M. B. Waite, No. 122, August 11, 1885, Oregon, Ogle County, Ill.

17. Plasmopara gonolobi (Lagerheim) Swingle.

1891. *Peronospora gonolobi*, Lagerheim. Observations on new species of fungi from North and South America. <Jour. of Mycol., Vol. VII, p. 49.

On leaves of Asclepiadaceæ.

On *Gonolobus suberosus*, R. Br. W. T. Swingle, No. 4001, Oct. 10, 1891, Still Pond, Kent County, Md. Conidiophores only, hypophyllous. Prof. W. G. Farlow has kindly compared my specimens with a part of those from which Prof. Lagerheim described the species and pronounces them identical. The species has the typical branching of *Plasmopara*. The conidia germinate readily in water producing zoöspores which have two cilia.

Measurements of sixty conidia are herewith appended.

Table of measurements of sixty conidia of Plasmopara gonolobi (Lagerheim), Swingle.*

16½ by 15	19½ by 17¼	22½ by 18	25 by 20
16½ by 16½	20 by 17	22½ by 18	25½ by 18
18 by 15	21 by 15¾	22½ by 19½	25½ by 18
18 by 15	21 by 16½	22½ by 19½	25½ by 18¾
18 by 16½	21 by 16½	22½ by 20¼	25½ by 19½
19½ by 14¼	21 by 17¼	23 by 19	25½ by 19½
19½ by 15¾	21 by 17¼	24 by 15¾	25½ by 21¾
19½ by 15¾	21 by 17¼	24 by 19½	25½ by 22½
19½ by 16	21 by 18	24 by 19½	25½ by 24¾
19½ by 16½	21 by 18¾	24 by 19½	26½ by 21
19½ by 16½	21 by 19½	24 by 19½	27 by 19½
19½ by 16½	21¾ by 16½	24 by 20¼	27 by 21
19½ by 16½	21¾ by 18	24 by 21	27 by 21
19½ by 16½	21¾ by 18¾	24¾ by 18¾	34½ by 24¾
19½ by 16½	22½ by 18	24¾ by 19	42 by 26

18. **Bremia lactucæ**, Regel. Beiträge z. Kennt. einiger Blattpilze. Bot. Zeit., 1843, p. 665.

On leaves of Compositæ, Tribe Cichoriaceæ. Conidiophores hypophyllous, on both radical and cauline leaves.

On *Krigia Dandelion*, Nutt. F. S. Earle, May 10, 1884, Cobden, Union County, Ill.

On *Lactuca Canadensis*, L. B. T. Galloway, June 1887, Columbia, Boone County, Mo.; W. A. Kellerman, No. 29, June 6, 1882, Lexington, Fayette County, Ky.; M. B. Waite, No. 120, August 26, 1885, Oregon, Ogle County, Ill.

On *Lactuca integrifolia*, Bigel. W. T. Swingle, No. 4020, September 20, 1891, Garrett Park, Montgomery County, Md.

On *Lactuca leucophæa*, Gray. W. T. Swingle, No. 4021, October 29, 1891, Rockville, Montgomery County, Md.

On *Lactuca sativa*, L. E. A. Southworth, December 8, 1891, Reeves Station, Md.

On *Lactuca* (sp.?). P. H. Dorsett, May 21, 1891, Benning's Station, Md.; F. S. Earle, June 17, 1883, Anna, Union County, Ill.; W. T. Swingle, No. 4022, September 17, 1891, Sterling, Loudoun County, Va.; M. B. Waite, (Herb. Div. Veg. Path. No. 525), September 27, 1889, Mt. Carmel, Wabash County, Ill.; W. T. Swingle, No. 4023, October 25, 1891, Bethesda Park, Montgomery County, Md.

PERONOSPORA.

Corda, Icones fungorum hucusque cognitorum, I, p. 20.

§ *Calothecæ.*

19. **Peronospora arenariæ** (Berkeley) Tulasne, Note sur les champignons entophytes, tels que celui de la Pomme de terre. <Compt. Rend. d. l'Acad. d. Sciences, t. 38, 26 Juin, 1854, p. 1102 and 1103.

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* These conidia were measured from fresh specimens (from Still Pond, Md., coll. Oct. 10, 1891) in water by Miss May Varney with a Zeiss F. obj. 3 oc. 169 mm. tube length. One division of the eyepiece micrometer equaled 1½ μ's. The measurements are given in μ's.

1846. *Botrytis arenariæ* Berkeley. Observations, Botanical and Physiological, on the Potato Murrain. Journ. Hort. Soc. London, vol. 1, p. 31, pl. 4, f. 22.
Var. **macrospora** Farlow. Additions to the Peronosporeæ of the United States, No. 12 *, Bot. Gaz., vol. IX, No. 3, Mar., 1884, p. 38.

On *Silene* sp. (?). F. S. Earle, April 24, 1884, Anna, Union County, Ill. As no oöspores were seen the identification of this specimen is somewhat doubtful.

20. **Peronospora alsinearum** Caspary. Ueber einige Hyphomyceten mit zwei-und dreierlei Früchten, No. 8. <Bericht über die zur Bekanntmachung geeigneten Verhandlungen K. Preuss. Ak. der Wissensch. zu Berlin, 1855. Berlin, Sitzung phys. math. Klasse vom 14. Mai, 1855, p. 330.

On *Cerastium nutans* Raf. M. B. Waite, No. 262, May 19, 1888, Urbana, Champaign County, Ill. With mature oöspores in lower leaves.

On *Cerastium viscosum* L. (?). S. M. Tracy, April 1, 1888, Starkville, Oktibbeha County, Miss. With mature oöspores in stems.

On *Cerastium vulgatum*, L. S. M. Tracy, April 4, 1888, Starkville, Oktibbeha County, Miss. Conidophores very scarce, oöspores mature and abundant in stems, leaves, and calyces.

21. **Peronospora viciæ** (Berkeley) Caspary. Ueber einige Hyphomyceten mit zwei-und dreierlei Früchten. <Bericht über die zur Bekanntmachung geeigneten Verh. K. Preuss. Ak. der Wissensch. zu Berlin, 1855. Sitzung. der physik. math. Klasse vom 14. Mai, 1855, p. 330.

1846. *Botrytis Viciæ* Berkeley. Observations, Botanical and Physiological, on the Potato Murrain. <Jour. Hort. Soc. of London, vol. I, p. 31, pl. 4, fig. 23.

On leaves, stems, and inflorescences of Leguminosæ, suborder Papilionaceæ, tribe Vicieæ.

On *Vicia sativa* L. W. T. Swingle, No. 4031, May 22, 1891, along drainage ditches by roadsides, east of Norfolk, Norfolk County, Va.

On *Vicia* (sp.?). E. A. Southworth, January 13, 1890, Washington, D. C.

22. **Peronospora calotheca** De Bary. Rabenhorst, <Klotzschii herb. viv. myc., ed. 2, Cent. VII, No. 673 1858; also <Botanische Zeit., XVI Jahrg., 1858, p. 58.

On leaves of Rubiaceæ.

On *Galium aparine* L. M. B. Waite, No. 267, May 12, 1888, Urbana, Champaign County, Ill. M. B. Waite, No. 547, May 29, 1888, Urbana, Champaign County, Ill. With mature oöspores in leaves and stems. E. W. D. Holway, June 7, 1884, Decorah County, Iowa.

23. **Peronospora Arthuri** Farlow. Enumeration of the Peronosporeæ of the United States, No. 13, <Bot. Gaz., vol. VIII, October, 1883, p. 315.

On leaves of Onagraceæ.

On *Œnothera biennis*, L. E. A. Southworth, May 1, 1891, College Station, Prince George County, Md. C. A. Hart, May 15, 1883, Normal, Union County, Ill. E. W. D. Holway, June 7, 1884, Decorah, Winneshiek County, Iowa. M. B. Waite, No. 539, June 22, 1885, Oregon, Ogle County, Ill. M. B. Waite, No. 262, July 4, 1888, Champaign, Champaign County, Ill. With mature oöspores in leaves.

24. **Peronospora myosotidis** De Bary. <Rabenhorst, Fungi europæi. No. 572.

On leaves of Borraginaceæ.

On *Myosotis verna*, Nutt. F. S. Earle, April 24, 1884, Anna, Union County, Ill. With abundant mature oöspores in stems.

§ *Leiothecæ:* Subsection *parasiticæ.*

25. Peronospora corydalis De Bary. Rech. s. le développm. de quelq. champ. parasites. <Ann. Sci. Nat., 4e. sér., Bot. t. xx, cahier. I, Paris, 1863, p. 111. (p. 107 of the reprint).

On leaves of Fumariaceæ.

On *Corydalis* sp. (?). B. T. Galloway, May 6, 1888, Rock Creek, Washington, D. C.

On *Dicentra cucullaria*, DC. M. B. Waite, No. 554, April 20, 1888, High Island, Montgomery County, Md. With mature oöspores in leaves.

26. Peronospora parasitica (Persoon). Fries Summa veg. scand. sect. post, p. 493 (1849).

1796. *Botrytis parasitica* Persoon. Obs. mycologicæ pars. I, p. 96, t. 5, figs. 5, *a*, *b*.

On leaves and stems of Cruciferæ.

On *Dentaria heterophylla*, Nutt. M. B. Waite, No. 549, April 14, 1889, Roslyn, Alexandria County, Va.

On *Dentaria laciniata*, Muhl. E. A. Southworth, April 25, 1891, Rock Creek, Washington, D. C. With immature oöspores on leaves. B. T. Galloway, May 3, 1891, Garrett Park, Montgomery County, Md. With mature oöspores in leaves. M. B. Waite, No. 537, May, 1888, Oregon, Ogle County, Ill. Erwin F. Smith, May 8, 1889, Still Pond, Kent County, Md., with immature oospores in leaves! Some of the conidiophores have a very thick unbranched basal portion, as much as 25 μ in diameter at the base in several cases. J. J. Davis, May 20, 1887, Racine, Racine County, Wis. With immature oöspores in leaves. M. B. Waite, No. 268, June 1, 1888, Oregon, Ogle County, Ill. With mature oöspores in leaves. W. G. Clinton, 18—, Buffalo, Erie County, N. Y.

On *Draba Caroliniana* Walt. M. B. Waite, No. 269, June 1, 1888, Oregon, Ogle County, Ill. With mature oöspores in leaves.

On *Sisymbrium canescens* Nutt. Francis A. Wentz, summer, 1886 (?), Spearville, Ford County, Kans. With nearly mature oöspores in stems.

On *Lepidium intermedium* Gray. T. A. Williams, No. 287, May 30, 1890, Ashland, Saunders County, Nebr. With conidiophores on leaves, and abundant mature oöspores in leaves (!) and stems.

On *Lepidium Virginicum* L. M. B. Waite, No. 548, May 28, 1888, Oregon, Ogle County, Ill. With mature oöspores in leaves.

On *Arabis Holbœllii*, Hornem. S. M. Tracy, No. 720, August 20, 1887, Marshall Pass, Saguache County, Colo.

27. Peronospora potentillæ De Bary. Rech. s. l. développm. de quelq. champ. parasites. <Ann. Sci. Nat., 4e sér. Bot., t. xx, Paris 1863, p. 124 (p. 120 of the reprint).

On leaves of Rosaceæ, Tribe Potentillæ.

On *Geum album* Gmelin. E. M. Fisher, No. 68, July 22, 1890, Needham, Johnson County, Ind.

On *Potentilla Norvegica* L. E. A. Southworth, May 1, 1891, College

Station, Prince George's County, Md. B. T. Galloway, September 25, 1891, Garrett Park, Montgomery County, Md.

28. Peronospora oxybaphi Ellis & Kellerman. New Kansas Fungi. <Jour. Mycol., Vol. 1, Manhattan, Jan., 1885, p. 2.

On leaves and petioles of Nyctaginaceæ.

On *Oxybaphus nyctagineus*, Sweet. T. A. Williams, No. 286, May 30, 890, Ashland, Saunders County, Nebr. Conidiophores hypophyllous, on leaves, mature oöspores in petioles.

Subsection *effusæ*.

29. Peronospora ficariæ Tulasne. Note sur les champignons entophytes, tels que celui de la Pomme de terre. <Comptes Rend. d. l'Acad d. Sciences, t. 38, Paris, Séance du 26 Juin, 1854, p. 1102–1103.

On leaves of Ranunculaceæ.

On *Ranunculus bulbosus* L. A. B. Seymour, May 12, 1883, Cambridge, Middlesex County, Mass.

On *Ranunculus fascicularis*, M. B. Waite, No. 542, May 31, 1888, Oregon, Ogle County, Ill. Rare.

30. Peronospora violæ De Bary. Rech. s. l. développm. de quelq. champ. parasites, <Ann. Sci. Nat., 4e sér. Bot., t. xx, 1863, p. 125 (p. 121 of the reprint).

On leaves of Violaceæ.

On *Viola tricolor* L., var. *arvensis*. S. M. Tracy, April 5, 1888, Starkville, Oktibbeha County, Miss. With nearly or quite mature oöspores in leaves. F. S. Earle, April 13, 1884, Cobden, Union County, Ill. With mature oöspores in stems and leaves.

31. Peronospora hydrophylli Waite. Descript. of two new species of Peronospora. <Jour. Mycol., Vol. VII, No. 2, p. 107, pl. XVII, figs. 17–24.

On leaves of Hydrophyllaceæ.

On *Hydrophyllum Virginicum* L. M. B. Waite, No. 559, May 5, 1889, High Island, Montgomery County, Md. M. B. Waite, No. 558, June 1, 1888, Oregon, Ogle County, Ill. A. S. Hitchcock, spring, 1888, Iowa City, Johnson County, Iowa.

32. Peoronspora dispaci Tulasne. Note sur les champignons endophytes, tels que celui de la Pomme de terre, < Comptes Rend. de l'Acad. d. Sciences, t. 28, Paris, Séance du 26 Juin, 1854, p. 1102–1103.

On leaves of Dipsaceæ.

On *Dipsacus yylvestris* Mill. C. H. Demetrio, July, 1884, Muench farm, Saline Creek, near Perryville, Perry County, Mo.

33. Peronospora grisea Unger. < Bot. Zeit, 1847, p. 315.
1833, *Botrytis grisea* Unger. Die Exanthemen der Pflanzen, p. 172.

On leaves of Scrophulariaceæ.

On *Veronica arvensis* L. M. B. Waite, No. 541, May 7, 1883, Urbana, Champaign County, Ill. With abundant mature oöspores in leaves and stems.

34. Peronospora lophanthi Farlow. Enumeration of the Peronosporeæ of the United States, No. 31. <Bot. Gaz., Vol. VIII, No. 11, Nov., 1883, p. 333.

On leaves of Labiatæ.

On *Lophanthus nepetoides* Benth. M. B. Waite, No. 125, May 13, 1885, Urbana, Champaign County, Ill.

35. **Peronospora lamii** A. Braun. <Rabenhorst, Herb. Myc., Ed. 2, No. 325 (1859).

On leaves of Labiatæ.

On *Lamium amplexicaule*, L. W. T. Swingle, No. 4028, May 22, 1891, waste land in old fields 2 miles southeast of Norfolk, Norfolk County, Va. Conidiophores and nearly mature oöspores in leaves. I think these specimens should be referred to *Peronospora lamii*. About the only respect in which the Norfolk specimens differ from European collections I have examined is that the conidiophores are much more scanty. I have compared it with *P. lamii* in Krieger Fungi Sax, 195, on *Lamium purpureum*, L. from Konigsberg, Germany; de Thumen, Mycoth. universalis, No. 721, on *Lamium amplexicaule* from Pasma, Italy; and Saccardo, Mycoth. Veneta, No. 487, on *Lamium purpureum* from Vittorio, Italy.

36. **Peronospora alta** Fuckel. Fungi rhenani No. 39; Symbolae mycologicae, Beiträge zur Kenntniss der Rheinischen Pilze, p. 71. <Jahrb. Nassauischen Vereins für Naturk., Jahrg. 23 und 24.

On leaves of Plantaginaceæ.

On *Plantago Patagonica* Jacq., var. *aristata* Gr. W. T. Swingle, No. 4032, June 20, 1891, under the trees in a peach orchard, Griffin, Spalding County, Ga. The parasite was very abundant in one orchard on this host, which in some spots seemed to be seriously injured by it.

On *Plantago* Sp. (?) (*P. major* or *P. Rugelii*). M. B. Waite, No. 534, Oregon, Ogle County, Ill.; M. B. Waite, No. 261, June 8, 1888, Oregon, Ogle County, Ill.; J. J. Davis, June 15, 1887, Racine, Racine County, Wis.; E. M. Fisher, No. 60, July 20, 1890, Urmeyville, Johnson County, Ind.; E. M. Fisher, No. 60, September, 1890, Urmeyville, Johnson Couny, Ind.

37. **Peronospora effusa** (Greveille) Rabenhorst. Klotz. herb. viv. myc., No. 1880. 1824. *Botrytis effusa*, Greveille. <Flora edenensis, p. 468.

On leaves of Chenopodiaceæ.

On *Chenopodium album* L. M. B. Waite, No. 264, June 9, 1888, Oregon, Ogle County, Ill. With mature oöspores in dying leaves. M. B. Waite, No. 538, June 23, 1885, Oregon, Ogle County, Ill.; B. D. Halsted, July, 1885, Spirit Lake, Dickinson County, Iowa. With mature oöspores in leaves. W. T. Swingle, No. 4024, May 22, 1891, waste land east of Norfolk, Norfolk County, Va. E. M. Fisher, No. 196, September 17, 1890, Urmeyville, Johnson County, Ind.

38. **Peronospora rumicis** Corda. Icones fungorum hucusque cognitorum, t. i., p. 20, tab. v, f. 273.

On leaves of Polygonaceæ.

On *Polygonum dumetorum*, L. var. *scandens*, Gr. E. M. Fisher, No. 74, July 24, 1890, Urmeyville, Johnson County, Ind. M. B. Waite, No. 272, July 30, 1888, Champaign, Champaign County, Ill. E. M. Fisher, No. 74, September, 1890, Urmeyville, Johnson County, Ind.

39. Peronospora euphorbiæ Fuckel. Fungi rhenani No. 40; Symb. Myc., p. 71.

Conidia and oöspores on leaves and inflorescences at the ends of branches of Euphorbiaceæ.

On *Euphorbia humistrata* Engelm. J. M. Holzinger, No. 67, July 24, 1888, Winona, Winona County, Minn. Conidiophores abundant; hypophyllous on leaves and inflorescences.

On *Euphorbia cordifolia* Ell. E. Bartholomew, No. 435, August 15, 1891, Rockport, Rooks County, Kans. With immature oöspores in stems.

On *Euphorbia hirsuta* Engelm. E. Bartholomew, No. 434, August 10, 1891, Rockport, Rooks County, Kans. With immature oöspores in stems.

On *Euphorbia hypericifolia* L. W. T. Swingle, No. 4025, September 21, 1891. Low ground in a vineyard. Sterling, Loudoun County, Va. Conidiophores amphigenous on leaves. Oöspores sparing; immature in leaves. I found only a single plant attacked with the fungus; and of this plant but one small branch was affected. The leaves bore also *Æcidium euphorbiæ* Pers., and were thus doubly parasitized. The only other *Euphorbia* growing near (*E. corollata, L.*) seemed entirely free from Peronospora.

On *Euphorbia serpyllifolia* Pers. E. Bartholomew, No. 436, August 8, 1891, Rockport, Rooks County, Kans. With nearly mature oöspores in stems. J. M. Holzinger, No. 154, August 22, 1888, Winona, Winona County, Minn. Conidiophores very scarce, but leaves and inflorescences filled with nearly or quite mature oöspores.

§ doubtful.

40. Peronospora cubensis Berkeley & Curtis. Berkeley on a collection of fungi from Cuba, Part II, including those belonging to the families Gasteromycetes, Coniomycetes, Hyphomycetes, Physiomycetes. <Jour. Linn. Soc. Botany, Vol. 10, 1869, p. 363.

On leaves of Cucurbitaceæ.

On *Cucumis anguria.* T. L. Brunk, 1888, College Station, Brazos County, Tex. J. F. Howe, December 12, 1889, Anona, Hillsboro County, Fla.

On *Cucumis sativus.* T. L. Brunk, College Station, Brazos County, Tex. P. H. Dorsett, Garrett Park, Montgomery County, Md. This species did considerable damage this year to a small patch of cucumbers on rather low ground near Garrett Park, Md.

41. Peronospora celtidis Waite. Descript. of two new species of Peronospora. <Jour. Mycol., vol. 7, No. 2, p. 105, pl. XVII, figs. 1-16.

On leaves of Urticaceæ; tribe Celtideæ.

On *Celtis occidentalis* L. M. B. Waite, No. 556, October 7, 1891, Washington, D. C. With mature oöspores in leaves. M. B. Waite, No. 557, October 9, 1891, Washington, D. C. With mature oöspores in leaves. P. H. Dorsett and W. T. Swingle, No. 4026, October 10, 1891, mouth of Sassafras River, Still Pond, Kent County, Md. With mature oöspores in leaves. The specimens included in this number were collected on many individuals of a smooth-leaved form of *Celtis occidentalis*, which had slender, smooth twigs. The trees grew at the

edge of a wood at the top of the banks of a small stream. W. T. Swingle, No. 4027, October 10, 1891, Still Pond, Kent County, Md. With mature oöspores in leaves. This number includes leaves from two individuals of a rough-leaved, coarse-twigged form of the host, on which the fungus was rare. One individual was a good-sized tree, growing with those from which No. 4026 was collected; the other (No. 4027*a*) was a small sapling growing by the wayside.

42. Peronospora echinospermi Swingle.

1889. *Peronospora Cynoglossi* Burrill, var. (?) *Echinospermi* Swingle. A list of Kansas species of Peronosporaceæ No. 21. <Trans. of 20 and 21st meetings Kans. Acad. Sci. (1887–1888), Vol. XI, pp. 77–78.

Conidia and oöspores on leaves, stems, and fruits of Borraginaceæ.

On *Echinospermum Redowskii* Lehm., var. *cupulatum* Gr. E. Bartholomew, No. 469, June 10, 1891. Rockport, Rooks County, Kans. Conidiophores on leaves, stems, and calyces; oöspores in mesophyll of leaves, bark, parenchyma, and pith of stems and in walls of nutlets.

On *Echinospermum Redowskii* Lehm., var. *occidentale* Wats. F. W. Anderson, No. 10, May 27, 1887, Helena, Lewis and Clarke County, Mont. Conidia only on leaves. E. Bartholomew, No. 470, June 15, 1891, Rockport, Rooks County, Kans. Conidia on leaves, calyces, and stems; oöspores, bark, parenchyma of stems, and walls of nutlets.

Through the kindness of Mr. Bartholomew I have been able to obtain an abundance of mature oöspores of this form, and after a careful study I feel reasonably certain that it is specifically distinct from *P. cynoglossi* Burrill, to which I referred it as a doubtful variety in 1889.* The oöspores occur in great profusion in the cortical parenchyma of the stems, and occasionally beneath the thickened outer layer in the wall of the nutlets, in mesophyll of leaves and calyces and in pith of stems. It is noticeable that they occur only in thin-walled tissue, and of such tissue they seem to prefer the best nourished. The bark and the seeds, which contain nearly all the oöspores, resist decomposition longest after the death of the plant.

The oöspores are unusually large, in fact the largest I have studied, being 35 to 50 by 33 to 47 μ, mostly 38 to 45 by 36 to 42 μ, in diameter. They are rather dark-brown, nearly globose, have a thick (mostly 2 to 7 μ), brown epispore, whose surface is slightly undulating and furnished with curious markings.

These epispore markings consist of very narrow (one-eighth to one-half μ), irregular, interrupted zigzag lines, which occasionally anastomose. The lines do not appear to be raised markings, such as are common on oöspores of *Peronosporaceæ*, but rather lighter colored portions of the epispore wall.

In sections the epispore has a distinctly radiate structure, seeming to be composed of brown, radiating prisms, between which are narrow stripes of lighter-colored substance.

* A list of the Kansas species of Peronosporaceae loc. cit. I wish to correct an error on p. 77 of this list. The host plant of *P. cynoglossi* should be *Cynoglossum Virginicum* L., not *C. officinalis* L., as given.

Possibly the lines seen on the surface are due to this lighter colored substance between the prisms. The endospore is 2 to 3 μ thick and homogeneous. Undoubtedly its composition is quite different from that of the epispore. The sphere bounded by the endospore is very constant in size, being 28 to 38 μ, mostly 29 to 34 μ.

The mycelium is very variable in diameter, and is furnished with abundant haustoria. The haustoria are filiform and almost always unbranched. Near the base they are gradually narrowed till, at the point of union with the mycelium, they are only about half as thick as at the distal end. They are usually very much bent and contorted, often appearing like a tangled mass of filaments. They often attain considerable length, sometimes as much as 40 μ.

As I have already described* the conidiophores and conidia I need not speak of them here, except to mention that in examining conidia that had been treated with warm KHO solution, and thus rendered lifelike in shape, I saw a number that had still attached lateral germ tubes. I have, finally, to report a most remarkable form of the conidial fructification in the Montana specimens collected by F. W. Anderson. The conidiophores are less branched than in the Kansas specimens, and the antepenultimate and penultimate branches are shorter and the ultimate are shorter still. All branches are strongly tinged with fuliginous, while the Kansas specimens show only faint traces of coloration in the conidiophores. The most remarkable character of these specimens is the fact that the conidiophores issue from the stomata in dense groups often comprising 10–15 or even more members. In the Kansas specimen of *P. echinospermi* the conidiophores arise singly or more often in groups of 2–5 through the stomata. For the present, till more specimens can be obtained and, if possible, oöspores be found, I think this form had best be referred doubtfully to *P. echinospermi*.

I have compared *P. echinospermi* very carefully with *P. cynoglossi* Burrill and find besides the differences in the conidiophores and conidia which I pointed out in 1889, considerable differences in the oöspores. The oöspores of *P. cynoglossi* differ from those of *P. echinospermi* in being considerably smaller (25–30 μ diameter sec. Burrill, but in what I have measured 27–40 μ mostly 27–34 μ diameter), in having usually a thinner epispore which does not show the peculiar surface markings, and is indistinctly if at all radiate in structure.

Peronospora myosotidis De Bary, and *P. asperuginis* Schroeter, differ from *P. echinospermi* in the conidial fructification in which they approach more nearly *P. cynoglossi*. If the published descriptions are at all to be relied upon the oöspores of these two species are very different from those of *P. echinospermi*. Unfortunately I have not been able to find any oöspores of either of these species in the specimens at my dis posal. I append measurements (all given in μ's) of oöspores of *P.*

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*A list of Kansas species of Peronosporaceae, *loc. cit.*, pp. 77–78.

cynoglossi and *P. echinospermi*. Most of the oöspores were measured in actual sections, which were obtained with a microtome, but I also give a number of measurements of *P. echinospermi* in optical section, since it is the usual method of measuring, and therefore gives results more strictly comparable with published measurements of other species. I am, however, convinced that the study of oöspores in actual section offers great advantages over the common method of studying them in optical section.

Table of measurements of ten oöspores of Peronospora cynoglossi, Burrill, *in actual section.**

Diameter of oöspore.	Diameter of oöspores lacking epispore.	Thickness of endospore.	Thickness of epispore.	Diameter of oögonium.
27 by 25	18	1¼	2 –4	30 by 28
27 by 26	21	1¾	2 –4	32 by 30
30 by 26	24	2	2 –3	44 by 31
30 by 28	22	2	1 –3	32 by 29
30 by 28	24	2	2 –4	36 by 32
30 by 29	24	2	2 –4	36 by 30
32 by 30	27	2	1½–4	44 by 32
33 by 31	26	3	1½–3	38 by 32
34 by 31	27	2	2 –3	40 by 34
40 by 33	28	2	2½–5	40 by 35

* These oöspores were measured from a specimen on *Cynoglossum Virginicum*. (A. B. Seymour, Illinois State Laboratory of Natural History. No. 4703, May 16, 1882. Sanburn, Ill.) They were measured in actual section in water, as indicated in the other tabulations of measurements given. One division of the eye-piece micrometer equalled 2 μ. All measurements given in μ's. I am indebted to Mr. Waite for this specimen, as well as for the permission to use his whole herbarium for comparisons.

Table of measurements of twenty-five oöspores of Peronospora echinospermi, Swingle, *in optical section.*†

Diameter of oöspore.	Diameter of oöspore without epispore.	Thickness of endospore.	Thickness of epispore.	Diameter of oögonium.
*38 by 36	31	2	3½ to 6	54 by 44
39 by 37½	30	1½	3¾ to 6	54 by 45
40 by 39	29	2	2 to 6	60 by 46
*40 by 39	33	2¼	3 to 5	58 by 50
40½ by 39	31½	1¾	4½ to 7½	54 by 54
42 by 40½	31½	1½	3 to 6	55½ by 54
42 by 40½	32½	1½	4½ to 7½	63 by 61
*42 by 41	32	1½	4 to 6	76 by 50
43½ by 37½	31½	2¼	4¾ to 9	61½ by 48
43½ by 39	30	2¼	6 to 7½	67½ by 48
43½ by 40½	30	1½	4½ to 9	63 by 42
43½ by 42	30¾	1½	4½ to 6¾	63 by 61½
45 by 42	32	1¾	4 to 7½	66 by 54
45 by 42	36	1½	6 to 9	69 by 55½
45 by 44	33	2½	4 to 6	54 by 52
*45 by 44	34	2½	4 to 5	60 by 56
*46 by 41	32	3	4 to 5	56 by 50
46 by 44	33	2	4 to 6	56 by 52
*46 by 46	35	2½	4	72 by 50
46½ by 45	35½	2¼	4½ to 7½	61½ by 52½
48 by 48	38	2½	4 to 5	72 by 54
*50 by 48	40	2½	3 to 5	78 by 60
51 by 40½	30	1½	4½ to 9	57 by 48
51 by 45	36	1½	6 to 11½	63 by 54
57 by 45	35½	2¼	6 to 13½	69 by 60

† These specimens were measured from oöspores teased out of the tissues from the same specimens and in the same manner as indicated in the following table of measurements. One division of the eye-piece micrometer equaled 2 μ. All were from *Echinospermum Redowskii* Lehm, var. *occidentale* Wats. except those marked with an asterisk (*), which were from *E. Redowskii* Lehm, var. *cupulatum*, Gr. All measurements in μ's.

Table of measurements of fifty oöspores of Peronospora echinospermi Swingle, *in actual section.**

Diameter of oöspore.	Diameter of oöspores without epispore.	Thickness of endospore.	Thickness of epispore.	Diameter of oögonium.
35 by 34	28 by 27	2	2½ to 2¾	40 by 38
36 by 33	32 by 28	2	3 to 4	54 by 40
36 by 34	28 by 27	2½	3 to 4	46 by 38
36 by 35	29 by 29	2½ to 3	2 to 4	44 by 38
36 by 36	28 by 28	2	3 to 6	52 by 44
38 by 33	29 by 27	2½	3 to 4	54 by 40
38 by 36	29 by 29	2½	2¾ to 4	46 by 44
38 by 36	30 by 30	2½ to 3	3 to 5	47 by 22
38 by 37	30½ by 30½	2	3 to 4	50 by 40
39 by 34	31 by 27	2½	2½ to 4	48 by 36
39 by 38	30 by 30	2½	2½ to 4	62 by 46
40 by 34	30 by 30	2¾	3 to 4	46 by 40
*40 by 35	32 by 28	2½	4 to 4½	50 by 42
40 by 36	32 by 26	2	3 to 4	59 by 41
40 by 37	30 by 30	2	4 to 7	46 by 40
40 by 38	32 by 32	2	2¾ to 5	57 by 42
40 by 39	29 by 29	2½	5 to 6	50 by 46
40 by 39	30 by 30	3	4 to 5	68 by 46
40 by 40	29 by 29	2½	4½ to 8	54 by 50
40 by 40	31 by 31	2	4 to 5	48 by 42
40½ by 39	31 by 31	3	4 to 6	54 by 50
41 by 38	30 by 30	2	4 to 6	70 by 40
41 by 40	30 by 30	2½	2¾ to 5	54 by 42
41 by 40	31½ by 28	2	4 to 6	62 by 42
*42 by 34	32 by 25	2	4½ to 4	52 by 38
42 by 38	28½ by 28½	2	4 to 6	44 by 42
42 by 38½	29 by 29	2	2½ to 10½	54 by 54
42 by 38½	30 by 28	2	4 to 8	52 by 44
42 by 38½	31 by 30	2 to 2½	4 to 6½	52 by 46
42 by 40	30 by 30	2	3 to 8	50 by 46
42 by 40	30 by 30	2½	4 to 6	46 by 44
*42 by 40	31 by 31	2½	4 to 5	50 by 50
42 by 42	30 by 30	3	4 to 6	58 by 52
43 by 42	30 by 30	2 to 2½	4½ to 5	50 by 48
44 by 40	32 by 32	2½ to 3	4 to 7	54 by 48
44 by 40	34 by 31	2	2¾ to 4	52 by 46
*44 by 40	34 by 31	2½	4 to 5	62 by 60
*44 by 40	36 by 32	2½	3¾ to 4	56 by 50
*44 by 41	33 by 32	2½	4 to 4½	54 by 44
*44 by 41	33 by 32	2	4 to 5	50 by 46
44 by 42	32 by 32	2 to 2½	4 to 6	50 by 48
44½ by 40	32 by 32	3	5 to 6	54 by 42
44½ by 42	31½ by 31½	2 to 2½	4½ to 7½	60 by 52
45 by 45	34 by 34	4	4 to 5	64 by 54
46 by 41	31 by 31	2½	4 to 5	52 by 48
46 by 42	31 by 31	2	4½ to 7½	59 by 52
*46 by 42	33 by 31	3	4 to 6	60 by 46
48 by 45	35 by 35	2½	4 to 7	59 by 51
48 by 47	34 by 34	2½	4 to 8	60 by 52
50 by 45	38 by 38	4	4 to 6	64 by 62
Extremes.				
35 to 50 by 33 to 47	28 by 28 to 38 by 38	2 to 4	2½ to 10½	40 to 64 by 22 to 62
Most common sizes.				
38 to 45 by 36 to 42	29 by 29 to 34 by 34	2 to 3	2½ to 7	46 to 60 by 42 to 52

* All the measurements are from actual sections made through the middle portions of the oöspores. The specimens were treated with hot water first, and were afterward studied in water alone. In measuring, Zeiss's 2mm. homog. immers. obj., 6 compen. ocular, etc., were used, and with a tubelength of 159½ mm.; one division of the eyepiece equaled 2μ. These measurements were all made from specimens collected by E. Bartholomew. All were from specimens collected on *Echinospermum Redowskii* Lehm., var. *occidentale* Wats. Collected June 15, 1891, except those marked with an asterisk (*), which were on *E. Redowskii*, var. *cupulatum* Gr., collected June 10, 1891. All measurements given in μ's.

43. Peronospora claytoniæ Farlow. Enumeration of the Peronosporeæ of the United States, No. 11, <Bot. Gaz., vol. VIII, No. 10, October, 1883, p. 314.

On leaves of Portulacaceæ.

On *Claytonia Virginica* L. M. Varney, April 28, 1891, Piney Branch, Rock Creek, D. C.

44. Peronospora rubi. Rabenhorst, Fungi europæi, No. 2676. (1882.)

On leaves of Rosaceæ, tribe Rubeæ.

On *Rubus villosus* Ait. M. B. Waite, No. 270, September 8, 1888, Oregon, Ogle County, Ill. M. B. Waite, No. 271, September 10, 1888, Oregon, Ogle County, Ill. M. B. Waite, No. 279, September 10, 1889, Oregon, Ogle County, Ill. M. B. Waite, No. 560, Oct. 7, 1891, Zoolog. Park, Washington, D. C.

On *Rubus Canadensis* L. P. H. Dorsett and W. T. Swingle, No. 4029, October 29, 1891, Garrett Park, Montgomery County, Md. W. T. Swingle, No. 4030, October 29, 1891, Rockville, Montgomery County, Md. B. T. Galloway and P. H. Dorsett, November 8, 1891, Garrett Park, Montgomery County, Md. In the fall of 1891 many of the individuals of this host showed the bright red spots caused by the parasite.

45. Peronospora sparsa Berkeley. <Gard. Chron. and Agric. Gaz., London, April 5, 1862, pp. 307 and 308 with fig.

On leaves of Rosaceæ, tribe Roseæ.

On *Rosa* sp. cult. D. G. Fairchild, June, 1891, in greenhouse Geneva, Ontario County, N. Y. Mr. Fairchild reports this species as very destructive, completely defoliating the plants. Bordeaux mixture was afterward used with good success in preventing it.

46. Peronospora sordida Berkeley & Broome. Notices of British Fungi, No. 953. <Ann. and Mag. Nat. His., 3d ser., vol. VII, London, June, 1861, p. 449.

On leaves of Scrophulariaceæ.

On *Scrophularia nodosa* L. C. H. Demetrio, June, 1889, Sweet Springs, Saline County, Mo. M. B. Waite, No. 536, August 25, 1888, Urbana, Champaign County, Ill. M. B. Waite, No. 543, September 11, 1888, Rochelle, Ogle County, Ill. M. B. Waite, No. 317, September 14, 1889, Oregon, Ogle County, Ill. M. B. Waite, No. 142, September, 1889, Oregon, Ogle County, Ill.

NEW SPECIES OF FUNGI.

By J. B. ELLIS and B. M. EVERHART.

PUCCINIA SUKSDORFII, *n. sp.*—On leaves of *Troximon glaucum*. Washington (Suksdorf) and Helena, Mont. (Kelsey). I and II not seen; (III) sori small, black, naked almost from the first, subconfluent, amphigenous, the leaf often marked with a small round purplish spot on the side opposite the sori. Teleutospores short-elliptical, obtuse and broadly rounded at both ends, deep brown, granular-roughened all over as if sprinkled with minute grains of sugar, constricted at the septum; -50 × 25–30 μ, on pedicels scarcely longer than the spores.

PUCCINIA AGROPYRI, *n. sp.*—On leaves of *Agropyrum glaucum*. Montana, August, 1890. (F. D. Kelsey). (II) Sori epiphyllous, narrow, oblong or linear, short, cinnamon-yellow, only slightly elevated. Uredospores subglobose, ovoid or elliptical, pale, 20–25 × 18–22 μ; epispore tolerably thick and smooth, pedicels short. (III) Sori hypophyllous, oblong or linear, short, black, covered (almost permanently) by the lead-colored epidermis. Teleutospores cylindric-clavate, 60–75 × 20–25 μ, moderately constricted, pale, squarely truncate, broader and darker but scarcely thickened at the apex, sometimes obliquely truncate or rounded or even obtusely pointed. Pedicels short.

STICTIS COMPRESSA, *n. sp.*—On dead limbs of *Carpinus Americana*. London, Canada, May, 1891. (Dearness, No. 627.) Ascomata scattered or gregarious, immersed, compressed $1\frac{1}{2} \times \frac{1}{3}^{mm}$ sunk in the wood; erumpent above in a small, round, white, minutely perforated, slightly prominent disk. Asci cylindrical, 225–260 × 10 μ, with abundant filiform paraphyses. Sporidia filiform, 220–240 × $1\frac{1}{2}$ μ, nucleate. Differs from the ordinary type in its minute disk with only a small central perforation.

TRYBLIDIELLA PYGMÆA, *n. sp.*—On weather-beaten wood, Ohio. (Morgan, No. 961). Perithecia acutely-elliptical, erumpent, not polished, black, $\frac{3}{4}$–1^{mm} long, lips loosely closed when dry. Asci oblong, 65–80 × 15 μ including the short, abrupt stipe, paraphysate, 4-8 spored. Sporidia subbiseriate, fusoid-oblong, 3-septate, pale brown (hyaline at first). 16–20 × 6–7 μ, ends subobtuse.

VALSARIA HYPOXYLOIDES, *n. sp.*—On bark of some tree or shrub. Central Paraguay, South America. (Morong, No. 1431. Communicated by Dr. J. W. Eckfeldt.) Stromata erumpent, superficial, subcarnose, subseriate, subglobose, $\frac{1}{2}^{mm}$ in diameter, narrowed at base, purplish rust-color, appearing almost exactly like *Hypoxylon fuscum* (Pers), in color and shape. Perithecia peripherical, ovate, small, less than $\frac{1}{4}^{mm}$ high, seated on the ovate, cinereous-gray core of the stroma, and barely covered by the thin outer layer. Ostiola subdiscoid or convex, umbilicate, black. Asci cylindrical, 90–115 × 12 μ, subsessile, paraphy, sate, 8-spored. Sporidia uniseriate, oblong-elliptical, 1-septate, dark brown, scarcely constricted, 12–15 × 7–9 μ. When the colored subferruginous coat is rubbed off the stroma is nearly black. Differs from *Hypoxylon* only in its soft stroma and uniseptate sporidia.

PHYLLOSTICTA GELSEMII, *n. sp.*—On leaves of *Gelsemium sempervirens* (cult.) Newfield, N. J., April, 1891. Spots suborbicular, 2–4^{mm} in diameter, or often occupying the apex of the leaf, pale yellow-brown with a purple border. Perithecia amphigenous, sublenticular, black, small, gregarious, shining, rather more abundant above. Sporules oblong-cylindrical, 12-16 × 3 μ.

PHYLLOSTICTA RHODODENDRI, *West.*—On leaves of *Rhododendron Catawbiense*. Newfield, N. J., April 20, 1891. Spots large; 1-3^{cm}, mostly marginal, dark reddish-brown, concentrically zoned, definitely

limited, the living part of the leaf bordering the spots narrowly shaded with yellow. Perithecia innate, sunk in the parenchyma of the leaf, the dark apex barely visible and only very slightly prominent, epiphyllous, about 150 μ in diameter. Sporules narrowly and acutely elliptical, hyaline, continuous, often binucleate, 15–20 × 6–7 μ.

SPHÆROPSIS ALBESCENS, *n. sp.*—On dead limbs of *Negundo aceroides*. Brookings, S. Dak., September, 1891. (T. A. Williams.) Perithecia gregarious, globose, $\frac{1}{2}^{mm}$ in diameter, buried in the bark, but raising the epidermis into little pustules which are barely pierced by the papilliform ostiolum. Sporules oblong-elliptical, brown, continuous, obtuse, 15–20 × 8–10 μ. The perithecia are mostly found around the nodes of the smaller limbs, extending for a centimeter or more on each side of a bud, and the epidermis over these areas becomes whitened out.

STAGONOSPORA SPINACIÆ, *n. sp.*—On spinach, Brookings, S. Dak., July, 1891. (T. A. Williams.) Spots amphigenous, round, dirty white, 3–5^{mm} in diameter, without any very distinct border. Perithecia epiphyllous, erumpent, rough, black, subhemispherical, 75–100 μ in diameter, with a papilliform ostiolum. Sporules oblong-cylindrical, obtuse, often slightly curved, hyaline, 1–3 septate, 15–30 × 8–10 μ.

SEPTORIA ELYMI, *n. sp.*—On leaves of *Elymus Canadensis*. London, Canada, July, 1891. (Dearness, No. 808.) Perithecia subglobose, 100–120 μ in diameter, epiphyllous, mostly on narrow, dirty white spots 3–4^{mm} long by $\frac{1}{2}^{mm}$ wide, visible as black specks. Sporules clavate-cylindrical, bent or curved, continuous, faintly nucleate, 15–25 × $1\frac{1}{2}$–2 μ. Differs from *S. bromi* Sacc., in its shorter sporules and narrow, elongated spots.

SEPTORIA JACKMANI, *n. sp.*—On leaves of *Clematis Jackmani* in a hothouse, Geneva, N. Y., August, 1891. (D. G. Fairchild.) Amphigenous. Perithecia large, conic-hemispherical, black, broadly perforated above, semi-immersed, the upper half projecting; gregarious on yellowish, indefinite spots. Sporules, clavate-filiform, 40–70 × $2\frac{1}{2}$–3 μ nucleate, but not visibly septate, thicker above, subattenuated below, only moderately curved. This is quite different from *S. Clematidis*, Rab., which is on definite, brown spots, and has smaller perithecia and smaller sporules. It is much nearer *S. expansa*, Niessl., but, besides the different host plant, that species is hypophyllous and has narrower ($1\frac{1}{2}$–2 μ) sporules. Saccardo in *Sylloge* gives the sporules as only 1 μ thick, but in the specimen in Rabenhorst-Winter Fungi Europæi, 2897, the sporules are, as just stated, $1\frac{1}{2}$–2 μ thick.

SEPTORIA SACCHARINA, *n. sp.* —On living leaves of seedling maples (*Acer saccharinum*), Niagara, Canada, August, 1891. (Dearness, No. 1812.) Spots amphigenous, scattered, small, definite, white, more obscure below, 1^{mm} in diameter. Perithecia few ($\frac{1}{2}$ on a spot), epiphyllous, lenticular, brown, 200 μ diameter. Sporules clavate-cylindrical, nucleate, hyaline, 40–50 × $1\frac{1}{2}$–2 μ. Distinguished from the other acericolous Septorias by the small, white spots.

SEPTORIA DRUMMONDII, *n. sp.*—On leaves of *Phlox Drummondii.* ondon, Canada, September, 1891. (Dearness, No. 820.) Differs from *S. varicata* E. & E. on *Phlox divaricata* (this JOURNAL, Vol. v, p. 151) the perithecia being scattered thickly over the entire surface of the af, and not on any definite spots. Perithecia black, subprominent, 0 μ in diameter. Sporules nearly straight, nucleate, 35–50 × 1½–2 μ, ther narrower at one end.

HENDERSONIA GEOGRAPHICA, *n. sp.*—On fallen and decaying chest-ut leaves. Newfield, N. J., April 4, 1891. Acervuli gregarious, on ale spots, dark brown, flattish, ¼–⅓^{mm} in diameter, mostly on the nerves f the leaf, and forming a kind of network, reminding one of *Asteroma eographica*, Fr. Sporules oblong-fusoid, pale brown, 3-septate, the erminal cells hyaline, acutely conical and 4–5 μ long, the colored part 0–12 × 3–3½ μ. Pedicels filiform, about 15 μ long, sometimes remaining ttached to the sporule. Terminal cell prolonged into a short, subulate eak, or oftener simply narrowed into a subulate point. The terminal ells are finally deciduous. Differs from *P. nervalis*, E. & E. (to which bears a strong resemblance) in its smaller, 3-septate sporules and arger acervuli.

GLŒOSPORIUM CATALPÆ, *n. sp.*—On living leaves of *Catalpa bignonioides.* Wilmington, Del., August, 1891. (Commons, No. 1804.) Spots rbicular, 2–3^{mm} in diameter; definite, reddish-brown, paler in the cen-er. Acervuli minute. Spores oblong, hyaline, continuous, 2-nucleate, 0–15 × 3–5 μ, erumpent on the upper side of the leaf in small, yellow-sh heaps.

GLŒOSPORIUM DECOLORANS, *n. sp.*—On leaves of *Acer rubrum.* London, Canada, August, 1891. (J. Dearness, No. 813.) Occupying the areas etween the main veins of the leaf, and causing large brown spots which ccupy the entire surface of the leaf except a narrow strip along each side of the midrib and its main branches. Acervuli numerous, small, erumpent on the lower side of the leaf. Spores oblong-elliptical, hyaline, 5–8 × 2½–3 μ. Very destructive to the leaves.

MELANCONIUM MAGNOLIÆ, *n. sp.*—On dead trunks of *Magnolia glauca.* Newfield, N. J., June, 1891. Acervuli sunk in the bark, ovate-conical, 1–1½^{mm} in diameter, substratum pale. Conidia obovate, pale olive brown, with a hyaline margin and a large nucleus, 12–15 × 9–11 μ on stout (4 μ thick), simple or branching, obscurely septate basidia, 50–75 μ long, erumpent in masses or black cirrhi, like coarse black hairs or black wool.

PESTALOZZIA LATERIPES, *n. sp.*—On dead legumes of *Cassia Chamæcrista.* Newfield, N. J., September and October, 1891. Perithecia pustuliform or subhysteriiform, about ¼^{mm} in diameter, with a large, irregular opening above, sometimes with an elongated slit, as in *Hysterium.* Sporules clavate-cylindrical, yellowish brown, 3-septate, the upper cell rounded above with a hyaline, subconical tip bearing at its apex a 3-parted crest of three, spreading slender bristles 15–20 μ long, the lower

cell narrower and furnished with an eccentric pedicel 10–12μ long, reminding one of a *Discosia*.

SCOLECOTRICHUM CARICÆ, *n. sp.*—On living leaves of *Carica papaya*. Lake Worth, Fla., March. 1891. (L. M. Underwood.) Maculicolous. Spots scattered, 1–2^{mm} in diameter, yellow above, becoming white in the center, suborbicular and definitely limited; completely covered below with densely crowded, minute, sphæriæform, black-brown tufts of the fungus. Basidia oblong or subclavate, continuous, 20–22 × 6–7μ, forming a compact peripherical layer on a minute tuberculiform base and bearing at their tips the ovate, uniseptate, pale brown, 12–20 × 8–10 μ. conidia.

MACROSPORIUM TABACINUM, *n. sp.*—On leaves of cultivated tobacco (*Nicotiana tabacum*), Raleigh, N. C., October, 1891. (Gerald McCarthy). Spots amphigenous, numerous, thin, white (rusty red or brown at first), suborbicular or irregular, 2–3^{mm} in diameter, definitely limited, with a narrow darker border. Fertile hyphæ effused, 35–45 × 3–4 μ, septate and torulose above. Conidia obovate, 15–25 × 10–12 μ, sessile, or longer (35–45 μ), narrowed below into a distinct stipe, 8–12 μ long. The shorter conidia are mostly 3-septate and the longer ones about 5-septate, one or two of the cells with a longitudinal septum. This is the "white speck" of the North Carolina planters.

MACROSPORIUM LONGIPES, *n. sp.*—On leaves of *Nicotiana tabacum*. Raleigh, N. C., October, 1891. (Gerald McCarthy.) Spots amphigenous, orbicular, rusty brown, 3-5 ^{mm} in diameter; orbicular, zonate. The entire leaf becomes brown and then the spots are a shade lighter than the surrounding parts. Fertile hyphæ effused on the spots, amphigenous, but more abundant above, slender (40–70 × 3–4 μ, septate and often constricted at the septa; erect, more or less torulose above. Conidia clavate, 40–50 × 15–20 μ, 3–7, mostly 5–6 septate, with two or more of the cells divided by a longitudinal septum, attenuated below into a distinct stipe 35–50 μ long, and often septate and torulose. This differs from *M. commune*, Rabh., in its effused hyphæ and smooth conidia, and from *M. tabacinum*, E. & E., in its brown, concentrically zoned spots and larger stipitate conidia. Known among the planters as "brown spot."

BRACHYSPORIUM CANADENSE, *n. sp.*—Parasitic on *Valsa ambiens?* On bark of dead maple limbs. Ottawa, Canada, October, 1890. (Macoun No. 49.) Hyphæ simple, brown; septate, 200–300 × 5 μ, forming dense, tobacco-brown, tuberculiform tufts, rising from the pustules of the *Valsa*. Conidia terminal, solitary, obovate-elliptical, pale brown, 1–3 septate, 20–40 × 12–15 μ.

CLASTEROSPORIUM POPULI, *n. sp.*—On dead places in living leaves of *Populus tremuloides*. London, Canada, June, 1891. (Dearness, No. 759.) On leaves of *Populus grandidentata*. Wilmington. Del. (Commons, No. 1806.) Conidia clavate, 1–2 septate, olive brown, 18–25 × 7–9 μ, mostly a little constricted at the septa, and subtruncate-apiculate at the apex; pedicles very short, almost none, subhyaline. The conidia arise directly

rom the cells of the leaf without any well-defined mycelium, and form ı continuous olive brown or green stratum on the lower surface of the eaf, beginning with well-defined brown spots which soon spread and ›ccupy the entire leaf—mostly the young terminal ones.

REVIEWS OF RECENT LITERATURE.

FARLOW, W. G., and SEYMOUR, A. B.—*A Provisional Host-index of the Fungi of the United States.* Part I, Polypetalae, pp. 1–52, Cambridge, 1888. Part II, Gamopetalae-Apetalae, pp. 53–134, Cambridge, September, 1890. Part III, pp. 135–220, Cambridge, June, 1891.

The issue of the third part of the above work, containing the endogens, cryptogams, and animals, and an addenda, together with an index to all three parts, finishes this most valuable and laborious work. As completed it contains 220 octavo pages. About 85 names on an average, including synonyms, are given on each page. The work will be a necessity to every American mycologist, and, aside from its direct value as a host-index, will be of very considerable worth as a guide to the synonomy of the American species of fungi. In accuracy and completeness it is almost without equal among mycological publications. It is to be wished, however, that a reference could have been given after each name of a fungus to one or more works in which it was reported on the host in question. It is likely that descriptions of some of the species will be troublesome to find. A title page for all three parts would also be a valuable addition.

Some interesting facts are revealed by a study of the index. The number of species reported on some genera of trees is truly astonishing. The family Cupuliferæ requires 24 pages, and these will probably average no less than 100 names ot fungi to a page. A most striking fact is the very small number of species reported on Algæ. Only two species, both *Chytridii*, are given. These occur on four species of Algæ. In Europe, on the contrary, where the algal parasites have been carefully studied, their number is very considerable, probably aggregating several hundred species.

Botanists everywhere would no doubt be very grateful if the authors of the "Host-index" could be induced to prepare the converse work, namely, a list of the species of fungi of the United States with their host plants.—W. T. SWINGLE.

FISCHER, DR. ALFRED.—*Phycomycetes.* Rabenhorst's Kryptogamenflora. I Band. IV Abtheilung: Pilze; 45, 46 and 47 Lieferungen, pp. 1-192. Leipzig. Ed. Kummer, 1892.

Part. IV of this important work begins with No. 45. Part III on Discomycetes by Dr. Rehm still lacks eight numbers of completion, but

the whole of Dr. Fischer's manuscript being in hand, the publisher has wisely concluded to begin publication at once. The lamented DeBary was to have written this volume, and it is a matter for congratulation that his mantle has fallen upon a competent successor.

In Winter's system (Pilze I, p. 32) the Phycomycetes are divided into two classes, Zygomycetes and Oömycetes. The position of the Chytridiaceæ remains doubtful and the Entomophthoreæ, now known to belong to Zygomycetes, are classed under Basidiomycetes. Since the appearance of this first volume so much new light has been thrown on the relationships of fungi that no excuse is necessary for departure from the old views, but some of the changes, *e. g.*, those under Peronosporinæ, will undoubtedly lead to criticism.

The name Phycomycetes, *i. e.*, alga-fungi, indicates the many-sided relationships of the group with certain algæ, *e. g.*, Siphoneæ (Vaucheria, etc.), not only in the possession of a nonseptate vegetative body, sexual organs, and swarm spores, but also in the aquatic life of many sorts. The nonseptate character of the mycelium is especially constant, so that the name Siphomyces, *i. e.*, tube fungi, might properly be used for the whole group, corresponding to the term Siphophyces applied to the parallel group of algæ. Cohn united under the name Siphomycetes the three orders Peronosporeæ, Saprolegnieæ, and Chytridiaceæ and set up the Zygomycetes (Mucorineæ, etc.) as a group parallel to the Zygophyceæ (Conjugateæ). In Cohn's system the Phycomycetes were therefore split into two groups, Zygomycetes and Siphomycetes. Sorokin uses the term Siphomycetes as synonymous with Phycomycetes, in the sense already explained, and although the author thinks Siphomycetes a better name for the group than Phycomycetes he considerately refrains from disturbing the well-established usage. However, it is not simply a question of names, but one of widely differing views as to relationships. De Bary in his Comparative Morphology and Biology puts Peronosporeæ (Ancylisteæ and Monoblepharis included), Saprolegnieæ, Mucorineæ, and Entomophthoreæ at the beginning of his great Ascomycetous series; but he treats the Chytridiaceæ as a group of doubtful position in the system, although recognizing their dependence on these Phycomycetes. Indeed, the disposition of the Chytridiaceæ is the weak point in all previous classifications. So far, all mycologists agree that Peronosporeæ, Saprolegneæ, Mucorineæ, and Entomophthoreæ are genuine Phycomycetes, but some do not regard the Chytridiaceæ as a natural group, *e. g.*, Zopf would separate the Synchitreæ from the Eu-mycetes on account of their plasmodial vegetative body, and would consider them as a special group related to Myxomycetes. In Saccardo's Sylloge (Vol. VII), the Chytridiaceæ are indeed included within the customary limits of the Phycomycetes, but are looked upon as degenerated forms. Brefeld in Heft viii regards the Chytridiaceæ as degenerate Phycomycetes in which the vegetative body is reduced more and more until it disappears entirely in the for-

mation of a sporangium. Thus, according to Brefeld and others, Olpidium represents the final member in a degeneration which began with Peronosporaceæ. The author's view is just the opposite of this. He regards Chytridiaceæ as a natural group and the simplest and earliest in point of time, *i. e.*, as the starting point of the whole great series which ends in the Oömycetes with richly branched mycelium.

Concerning disputed relationships he has the following: The Olpidiaceæ have much in common with the zoösporous Monadineæ, but the differences are still greater. One principal difference consists in the manner of taking food. In the Monadineæ this takes place through the active amœboid movements of the plasmodium by which solid substances are commonly taken up. In the Myxochytridineæ the amœboid movements of the naked vegetative body are always feeble or wholly wanting, and the taking up of solid bodies does not occur. Consequently while the Monadineæ take their food like the Myxomycetes, in the Myxochytridineæ there is only an absorption of dissolved food as in the genuine fungi. In connection with this stands the extrusion of undigested food balls, something which, of course, does not occur in the Myxochytridineæ. Together with the accompanying physiological differences due to the different manner of taking food, there are also important purely morphological differences. In a number of zoösporous Monadineæ (Aphelidium, Plasmodiophora) the amœboid body breaks up into spores without previous formation of membrane, but in those forms in which a wall is previously formed the swarm spores escape from the cyst at indefinite places, *i. e.*, there is no special canal for escape. The contrary is true for all the Myxochytridineæ except Sphærita. Finally it should be emphasized that not rarely the actively amœboid body becomes a genuine plasmodium, through the blending of several amœbæ, while genuine plasmodia are wanting in Myxochytridineæ, with the possible exception of Rozella. The relationship of the Myxochytridineæ with the Monadineæ is to be recognized, but on the other side there is also to be noted in the described departure a step toward the fungi. It is especially the Holochytriaceæ which show a transition into genuine mycelium. Forms like Myzocytium belong with the Myxochytridineæ on account of their holocarpal development, but differ in the elongated vegetative body, surrounded from the first by a membrane, which, by its branching, takes on a mycelial character.

Morphologically the Zygomycetes and Oömycetes can be very easily united to these Holochytriaceæ, as a further development, with a richly branched, eu-carpal, mycelial vegetative body.

The family of the Sporochytriaceæ with mycelial haustoria appears to me to join on to the Hyphochytriaceæ above. Among the Monadineæ, *Colpodella pugnax* shows a similar development but is distinguished by the absence of mycelium and the much later following wall formation. Finally the family of Hyphochytriaceæ which joins on to the Sporochytriaceæ (Polyphagus) is continued into Protomyces and the Ustilagineæ.

Under Phycomycetes the author includes all plants having the following characteristics:

Vegetative bodies one-celled, only forming septa during the production of reproductive organs, or when still older, sometimes unbranched and changing wholly into a sporangium (holocarpal), sometimes a richly branched mycelium with special reproductive organs (eu-carpal). Non-sexual reproduction by swarm spores or non-motile spores; sexual by zoöspores or oöspores.

The following is Dr. Fischer's classification:

PHYCOMYCETES (Siphomycetes).

I. Series. Archimycetes (Chytridiaceæ).
II. Series. Zygomycetes.
III. Series. Oomycetes.

Under the first series he gives the following subdivisions and family characters.

1. Order. Myxochytridineæ.

1. Family. Monolpidiaceæ (Olpidiaceæ).

The entire vegetative body changing holocarpally into a single spherical or elongated zoösporangium or one resting spore. Sexuality observed in one case.

2. Family. Merolpidiaceæ (Synchytriaceæ).

The entire vegetative body splits up holocarpally into a number of sporangia and produces a roundish or long one-rowed sporangial sorus. Resting state either a heap of resting spores, cystosori, or single resting spores, which arise from the entire undivided vegetative body or single parts of it.

2. Order. Mycochytridinæ.

1. Family. Holochytriaceæ (Ancylistaceæ).

Vegetable body tubeform or vermiform, unbranched or with short side branches, dividing by cross septa into a number of members, all of which change into reproductive organs (sporangia, oögonia, antheridia). Strictly holocarpal and monophagous, always intramatrical.

2. Family. Sporochytriaceæ (Rhizidiaceæ, Polyphagaceæ).

Vegetative body consisting of two parts, a spherical strong growing swarm spore, and a tenuous, thread-form, often very delicate, mycelial part. The ball-shaped part grows into a single sporangium, or into a single resting spore. Resting spores also develop in another manner from the mycelial part, or by the copulation of two plants. The mycelial part always perishes after one fructification, *i. e.*, it is strictly monocarpal, but also eu-carpal. There are two subfamilies, Metasporeæ, and Orthosporeæ.

3. Family. Hyphochytriaceæ (Cladochytriaceæ).

Vegetative body, a more or less branched and originally one-celled mycelium, which forms simultaneously a great number of terminal and intercalary swellings, and out of those zoösporangia or resting spores; eu-carpal, but mostly monocarpal: not perennial. Sexuality wanting.

Under the second series he gives:

1. Order. Mucorinæ.

1. Suborder. Sporangiophoræ.

1. Family. Mucoraceæ.

The cross wall which separates the stalk from the sporangium arches into the latter and projects as a columella, often far out. Zygospores naked, or only enveloped by a loose mycelial tissue, never inclosed in a compact receptacle and forming a fruit body. Three subfamilies, Mucoreæ, Thamnidieæ, and Piloboleæ.

2. Family. Mortierellaceæ.

Sporangium without a columella, with gelatinizing membrane. Zygospores single and completely inclosed in a receptacle (carposporium) like a small tuber.

2. Suborder. Conidiophoræ.

1. Family. Chætocladiaceæ.

Conidia single, spherical, in groups on the middle swollen part of the last branches of the conidiophore, the ends of the same remaining tenuous and sterile. Zygospores naked between the straight gametes.

2. Family. Cephalidaceæ.

Conidia in chains on the spherical-headed, swollen branch ends (sterigmata) of the unbranched conidiophore. Zygospores naked on the crown of the tongs-like gametes.

2. Order. Entomophthorinæ.

1. Family. Entomophthoraceæ.

With the characters of the order, *i. e.*, Mycelium mostly parasitic in living animals, rarely in plants, or saprophytic, richly branched, often falling into pieces, at first one-celled. Nonsexual reproduction by conidia which are delimited on the end of unbranched threads growing out of the substratum and thrown off when ripe, *i. e.*, no special conidiophores. Zygospores on the mycelium.

Under the third series he gives:

1. Order. Saprolegninæ.

1. Family. Saprolegniaceæ.

Antheridia applied to the oögonium like accessory branches, pushing fertilization tubes into the latter.

2. Family. Monoblepharidaceæ.

Antheridia with spermatozoids.

2. Order. Peronosporinæ.

1. Family. Peronosporaceæ.

With the characters of the order, *i. e.*, mycelium parasitic in the interior of living plants, richly branched, polycarpal. Nonsexual reproduction by swarm spores or conidia, mostly with specially formed conidiophores breaking out of the substratum. Oögonia always one-celled, with a remnant of unused protoplasm (periplasma). Antheridia applied to the oögonium like an accessory branch, with penetration tube.

1. Subfamily. Planoblastæ (Cystopodeæ).

Nonsexual reproduction by swarm spores. Sporangia, either persistent on mycelium or mostly falling as conidia and producing zoöspores in germination.

2. Subfamily. Siphoblastæ (Peronosporeæ).

Nonsexual reproduction by conidia, which germinate by germ tubes and are homologous to the falling zoösporangia of the Planoblastæ.

Under Archimycetes some general account is given of the group, including directions for collection and preparation of specimens. This is followed by a very convenient and useful key to the genera, 29 in all. The following genera and doubtful genera, including 144 good species and 39 doubtful ones, are described in these three numbers: Sphærita, Olpidium, Pseudolpidium (nov. gen. with figs.), Olpidiopsis, Pleotrachelus, Ectrogella, Pleolpidium (nov. gen. with figs.), Synchitrium, Woronina, Rhizomyxa, Rozella, Micromyces, Myzocytium, Achlyogeton, Lagenidium, Ancylistes, Resticularia, Rhizophidium, Rhyzidium, Rhizidiomyces, Achlyella, Septocarpus, Harpochytrium, Entophlyctis (nov. gen. with figs.), Rhizophlyctis (nov. gen. with figs.), Obelidium Chytridium, Polyphagus, Cladochytrium, Amœbochytrium, Catenaria, Hyphochytrium, Nephromyces, Aphanistis, Saccopodium, Zygochytrium, and Tetrachytrium. Only one new species is recorded, Olpidiopsis minor. The genera are illustrated by good figures and followed by a host index.

The treatment of the Zygomycetes is substantially the same as for the preceding series: first, fourteen pages outlining the main features of the order Mucorinæ, then a key to the genera, followed by a description of the species of the genus Mucor as far as the end of the first section, Mono-Mucor.

This volume, while devoted to the forms occurring in Germany, Austria, and Switzerland, can not fail to be of great service to American students, since many of the described species occur in this country. Reference to doubtful forms and extra-European ones also help to make the book indispensible.—ERWIN F. SMITH.

Fruit culture in foreign countries.—Reports from the consuls of the United States on fruit culture in their several districts in answer to a circular from the Department of State. Washington, Government Printing Office, 1890, pp. 391–937; Index, i–xiii.

This report is devoted principally to the citrous fruits, the olive, fig, and vine. Incidentally there are many references to the diseases of these plants, parasitic and nonparasitic. Some of the statements need to be taken *cum grano salis* because emanating from men not specially trained to observations of this kind, but on the whole the reports appear to be well written and will prove useful. A similar volume on the stone fruits of the world would be equally valuable.—ERWIN F. SMITH.

MANGIN, LOUIS.—(1) *Sur la callose, nouvelle substance fondamentale existant dans la membrane.* Comptes Rendus, Paris, tome CX, 24 Mars, 1890, p. 644.

(2) *Sur les réactifs colorants des substances fondamentales de la membrane.* Comptes Rendus, Paris, tome CXI, 15 Juillet, 1890, p. 120.

(3) *Sur la structure des Péronosporées.* Comptes Rendus, Paris, 15 Décembre, 1890, p. 923.

(4) *Sur la désarticulation des conidies chez les Péronosporées.* Bull. de la Soc. Bot. de France. Comptes Rendus des Séances, Paris, 1891, tome 38, pp. 176–184, 232–236, pl. 4.

(1) The author distinguishes three fundamental substances in the cell walls of plants—pectin compounds, cellulose, and callose. The latter has been studied quite carefully, and is described as a new fundamental substance, known hitherto only from sieve tubes. Not having been able to isolate it in sufficient purity for a chemical analysis, the author confines himself to an account of its distribution in plants.

Callose is colorless and amorphous, insoluble in water, alcohol, and Schweizer's reagent,* even after the action of acids; very soluble in soda or cold caustic potash 1 to 100, soluble cold in sulphuric acid, chloride of calcium, and concentrated bichloride of tin; insoluble cold in the alkaline carbonates, and in ammonia, which swells it and gives it a gelatinous consistency. Besides aniline blue and rosolic acid†

*Cuprammonia. †Known also as corallin, aurin, peonin.

already recommended by Russow and Janczewski for the study of liber, the color reagents of callose are certain substances of the series of azo colors, belonging to the group of benzidines, tolidenes, etc. Iodated reagents give to callose a yellow tint. Callose is therefore as distinct as cellulose or the pectin compounds. It is not a result of the artificial decomposition of the latter substances, for these may be treated in all sorts of ways without producing the reactions of callose. Its insolubility in the cuprammoniacal reagent, even after the action of acids, and the yellow color which it gives with iodated phosphoric acid distinguish it from cellulose, while its insolubility in cold ammonia and alkaline carbonates, and its inertia toward stains which act on the pectin compounds separate it not less clearly from the latter.

While callose exists normally in certain regions of the reproductive organs of phanærogams (pollen grains, pollen tubes, etc.) and vascular cryptograms, it is not found in the vegetative portions of these plants, exclusive of the liber, save accidentally and as irregular masses scattered through the cells. But in the thallophytes callose acquires a great importance. In the fungi it forms the membrane of the mycelium and of the organs of fructification in the most widely separated families; *e. g.*, Peronosporeæ, Saprolegniaceæ, Basidiomycetes, Ascomycetes, Saccharomycetes. In lichens callose exists in the mycelial filaments, but not in the gonidia. It does occur, however, in some of the algæ. On the other hand, he has not yet found it in certain Uredineæ, nor in the mycelium and conidiophores of the Mucorinæ. In the plants of this order Mucor, Phycomycetes, Rhizopus, Pilobolus, Chætocladium, etc., it constitutes only the dissolving wall of the sporangium, and some part of the membrane of the spores. Callose appears to be in a state of purity in the membrane of the sporangium of the Mucorinæ, but in the mycelium of the Peronosporinæ and Saprolegninæ it is intimately united with cellulose, to the exclusion of pectin compounds, and, finally, in the Polyporei (Dædalea), the mycelial tubes appear to be destitute of cellulose, and are formed of callose associated with substances having the reaction of pectin compounds.

Various circumstances often mask the presence of callose, such as physical differences or the incrustation of foreign substances, for example, the callose of pollen mother cells and that which forms irregular masses in the mycelium and haustoria of the Peronosporinæ presents the most alterable and easily distinguishable state. In the sporangium of the Mucorinæ and the mycelium of lichens the callose offers more resistance to the action of solvents and fixes stains less readily. Finally, in the Polyporei it coheres so strongly that its presence can be demonstrated only after long and repeated treatments.

(2) The various stains of the aromatic series may be divided into two groups, one consisting of basic colors united with various mineral or organic acids, the other of acid colors used in the form of alkaline salts. Substances of the first category are fixed with a variable energy

by pectin compounds, which thus reveal their acid function. They do not stain callose or cellulose. The following compounds are noteworthy. *Azo group* Vesuvin brown, chrysoidin; *diphenyl-methane group*, auramine; *triphenylmethane group*, the Victoria blues, bleu de nuit, fuchsine, Paris violet, Hofman's violet, etc., all the stains of the *oxazine group*, naphthaline blue, Nile blue; *thionine group*, methyl blue; *eurhodine group*, neutral red; *safranine group*, neutral blue, pheno-safranine, extra safranine, rosaline, Magdala red. The affinity of these substances for pectin compounds is very dissimilar. It is also feeble, for the presence of an excess of acid or of glycerine removes the stain from the tissues more or less readily.

The second category, formed of alkaline salts, contains a great number of substances which never stain pectin compounds. Many, however, are fixed by cellulose and callose, and thus show the basic nature of these latter, a nature already known and used for a long time, so far as concerns cellulose. In this category only two groups are of interest, the *azo group* and the *triphenylmethane group*. The azo group, exclusive of chrysoïdine and Vesuvin brown, is composed principally of alkaline salts. In this group we distinguish three important types. The first includes the various stains which contain the azo grouping once, *e. g.*, xylidine ponceau, aniline ponceau, toluidine ponceau, naphthorubin, etc., as well as various tropeolines of a slightly different composition. These substances stain protoplasm yellow, but they have no action on cellulose and callose. The second type is formed of substances containing the azo grouping twice, *e. g.*, orseille red, orseilline BB, azorubine, naphthol black, the croceines, etc. These substances stain cellulose in a neutral or slightly acid bath, but have no effect on callose. The third type contains the stains of the benzidine series, *e. g.* Congo red, Congo GR, Congo brilliant G, Corinthian Congo, extra Bordeaux, delta purpurine G, which result from the action of sulphonated naphthol compounds upon benzidine; azo blue, Corinthian Congo B, the benzo purpurines and the rosazurines, in which toluidine is substituted for benzidine; azo violet, the benzo azurines and heliotrope, where dianisidine is substituted for benzidine. These colors, ordinarily precipitated by acids, stain cellulose directly in a neutral or, better, a slightly alkaline bath.

The triphenylmethane group does not offer as distinct relations between staining capacity and chemical composition. We first distinguish a large number of bodies formed by chlorhydrates, sulphates, etc., which stain pectin compounds directly. Then a series of alkaline salts which may be divided into three groups. The first group includes acid fuchsine, acid violet, Bayer's blue, the alkaline blues, etc., which result from the respective action of sulphuric acid on fuchsine, Paris violet 6B, diphenylamine blue, and analine blue. These substances do not stain cellulose, but certain of them stain callose, *e. g.*, the soluble blues, and notably Bayer's blues. The staining is energetic

in proportion to the completeness of the sulphonization, *e. g.*, the blue 6B, a mixture in which trisulphonated triphenylrosanilin predominates, is the most active of the soluble blues. The second group is formed by the alkaline salts of rosolic acid, which stain callose and cellulose directly. Finally, the third group, the eosines, or salts or fluorescine such as eosine, erythrosine, and phloxine, stain nitrogenous matters deeply, but are not fixed by callose or cellulose.

As various stains of the aromatic series also combine with nitrogenous substances, to avoid error it is often indispensable that there should be a mixture of several reagents belonging to different categories. This gives a very demonstrative double stain.

(3) The constitution of the membrane of fungi is still unknown. The author believes that fungine and metacellulose do not exist as specifically distinct substances. The membrane of fungi is so complex and variable that it would be possible to offer the chemical composition in evidence whenever the absence of fructification rendered the determination of families uncertain.

In the group under consideration the membrane is composed of callose and cellulose closely associated. To show this, leaves containing *Peronospora ficariæ* may be treated as follows:

(*a*) Treat with concentrated chlorhydric acid; (*b*) macerate for some minutes in Schweizer's reagent. This removes all the cellulose and pectin compounds contained in the host and in the parasite. After washing in water, the use of iodated phosphoric acid or of the benzidine colors does not reveal a trace of cellulose in the tissue of the leaf, but the reagents of callose bring out a network of mycelial filaments. Contrarywise, if we submit the contaminated leaves of the Ranunculus to the action of Hofmeisters's chlorated mixture* and after washing allow the tissues to macerate in a solution of potassa or caustic soda, renewed several times, all the callose is removed without sensible modification of the cellulose. Then by the use of iodated reagents we can see the mycelial filaments stained blue or violet in the midst of the disassociated tissues of the host plant.

Thus either the cellulose or the callose can be removed without changing the form and arrangement of the mycelium. But while cellulose and callose are always associated in the organs which the parasite sends into the host (mycelium and oöspores), the conidiophores are formed of pure cellulose. This is proved by their disappearance after the action of cellulose solvents.

The mycelial membrane varies in thickness and shows numerous layers, but what gives the mycelium of the Peronosporinæ a special character is the constant presence of masses of callose, which is either pure or associated with cellulose. These constrict the cavity of the tube or even obliterate it. In the latter case, they form the so-called septa. These masses are seen very clearly in *Peronospora parasitica*, *P. Schleideni*, *P. myosotidis*, *Plasmopara viticola*, etc. They serve very clearly

to distinguish the Peronosporinæ from other parasites. Pollen tubes inside of tissues are the only bodies likely to be confounded with them, and this only in case of species with much reduced haustoria.

The haustoria have the same structure as the mycelium and their shape and varying size always furnish excellent data for distinction of species. They are sometimes so minute as to have thus far escaped the attention of botanists, *e. g.*, *Phytophthora infestans*, described in all the books as destitute of haustoria, possesses numerous ones which are extremely minute and filiform. Haustoria are simple or branched: (*a*) Simple and oval or spherical (*Cystopus candidus*, *Plasmopara viticola*. *Pl. epilobii*, *Peronospora leptosperma*, etc.); (*b*) Claviform and simple (*Bremia lactucæ*); (*c*) filiform and simple (*P. myosotidis*, *P. Schleideni*, *P. affinis*, *P. chloræ*, *Phytophora infestans*); (*d*) ramified and claviform (*P. parasitica*); (*e*) ramified and filiform (*P. arborescens*, *P. calotheca*, etc.). Ordinarily the haustoria have a double envelope and between these two envelopes irregular and voluminous masses of callose often occur and sometimes rupture the exterior membrane (*Cystopus candidus*, *P. myosotidis*, etc.). At other times the exterior membrane shows only cellulose and incloses little callose. It then forms a complete sheath around the haustorium which can be removed in connection with the mycelium by a slight traction (*P. Schleideni*). Sometimes the masses of callose formed by the haustoria are so abundant that they fill the entire cavity of the cell, the protoplasm being crowded against the wall.

Masses of callose in a state of purity are also found in the cavity of the conidiophores. They take the form of rings or irregular plugs, of most variable location. In any case these plugs can not be likened to the septa which form at the base of the sporangium of the Mucorinæ, as has been done. The only part of the conidiophores where the presence of callose is constant is the base of the conidia where this substance plays an important role in the dissemination of the spores.

To sum up, the constant presence of callose in the mycelium of the Peronosporinæ enables us to recognize with great clearness the least traces of these parasites in the host plants and to show clearly the relations which exist between the latter and the parasite.

(4) This paper is really a continuation of the last one. Observations on the formation and the separation of the conidia in *Cystopus candidus* led M. Mangin to the following conclusions: The septum first appears as a delicate ring of callose on the thin inner wall of the basidium. This ring gradually enlarges until only a small central opening remains. The septum then appears as a funnel minus its tube, the convexity of which projects toward the base of the basidium. The open central portion of the septum finally closes. About this time or a little sooner the thin cellulose wall of the basidium disappears at the level of the callose (is absorbed) and a constriction rapidly takes place, the base of the new conidium and the summit of the basidium rounding off by the

extension and growth of the cellulose membrane. The conidium is now attached to the basidium by a mass of callose in the form of a little cup embracing the slightly pyriform base of the conidium. The base of this cup is convex or plane, but the center often shows a little pit which is the last vestige of the previous funnel-form orifice.

No division of the connecting cupule into three layers, as described by Zalewski, was observed. At this stage it is pure callose. Soon the cupule contracts, its superior edges being reduced progressively, and it shortly takes on the form of a cylindric fragment uniting the conidia, but the cellulose membrane of the conidium or of the basidium is not yet continuous across the callose. Subsquently the cellulose wall of the upper part of the basidium is continued along the base of the callose plug or through it when the latter projects. A similar process takes place a little later at the lower end of the conidium when the cup form has almost disappeared. Sometimes this cross wall is outside of the callose band, sometimes it grows through it, imprisoning a portion within the conidium. It is generally only when the conidium is second in rank from the basidium that the cellulose membrane is completed. Up to this point the changes in the callose band have been due to absorption, but not so subsequently. The band of callose now changes chemically so as to become strongly hygroscopic and completely soluble in water or even in the vapor of water. This primary septum or connective band contains no pectin compounds and does not swell and become gelatinous previous to solution, as stated by de Bary and Zalewski. It is simply a very neat case of liquefaction.

New conidia are developed under the old ones in the following manner: The end of the basidium elongates by intercalary growth and a new ring of callose appears. This is not always in the same plane, but most often for each conidium or group of conidia it appears in a region nearer the summit, so that the lateral wall of the basidium presents a series of thickenings, which when stained appear as striæ. Each one of these striæ corresponds to a group of conidia, for they are always less numerous than the conidia successively developed from a basidium.

The formation of conidia finally ceases, and in old sori, long ruptured, it is easy to find such exhausted basidia drawn out to a naked point or terminated by a single conidium which appears to be incapable of completing its development. The membrane of the basidium is then notably thickened in the terminal region and more or less deformed. The striæ above mentioned are often visible and, finally, several rows of internal button-shaped thickenings are almost always present. These thickenings are composed either of pure callose or of a mixture of callose and cellulose.

The statements here given were also found to hold good for *Cystopus cubicus* and the closely related *C. spinulosus*. A somewhat similar method of growth and delimitation was studied in a form of *Plasmopara* found on *Epilobium montanum*. Here, however, the cellulose wall

at the base of the spore is reflected over the upper surface of the cal- lose somewhat early, but fades out toward the center. At this time the extremity of the basidium is expanded funnel-form, and the callose septum is biconvex. Later the cellulose wall of the spore becomes complete, but in just what way the author was not able to determine. The expanded end of the basidium shrinks and finally becomes drawn out to a point by the time the spore falls, but, contrary to Cornu, the tip still retains its callose plug and is not covered by a cellulose wall.

Reasoning by analogy, the author thinks the disarticulation of conidia in Peronosporæ takes place by a uniform mechanism. The paper is followed by a good lithographic plate (in part 5).

The following methods were employed to distinguish cellulose, callose, and protoplasm: Sections were first placed for some time in eau de Javelle* to remove plasmic matters. They were then washed in water and placed on slides with the addition of some drops of an alcoholic solution of soda or very concentrated caustic potash. After ten or twelve minutes they were neutralized with acetic acid and stained. Cellulose is colored a beautiful blue by a concentrated solution of iodated phosphoric acid. The stain is deep and instantaneous, the treatment with alkalies rendering the cellulose easier to stain. For callose one of the blues formed of trisulphonated triphenylrosaniline and soluble in water should be used. Since some nitrogenous matters may yet remain, it is well to mix one of these blues with a solution of acid brown (Bismarck, Vesuvin, etc). This mixture must always be used in an acid medium (acetic acid 3 to 100, formic acid 3 to 100). The cuticle and all azotic substances become brown, the cellulose remains colorless, and the callose becomes a brilliant greenish blue. After the action of this mixture, which requires some minutes, wash in water and mount in aqueous glycerine, in which the specimens will remain without bleaching for some months. Preparations treated with iodated phosphoric acid may be preserved in the same way and will keep for a long time if protected from the light.

In a footnote the author recommends the following dyes as especially serviceable: (1) For protoplasm, lignin, cutin, and pectin compounds: Blue de diphenylamine soluble in alcohol, blue de Bayer soluble in alcohol, bleu direct; bleu d'analine soluble in alcohol, bleu de gentiane 6B., bleu opal, bleu de nuit, bleu lumière. These blues do not stain callose. (2) For callose and protoplasm: Le bleu Nicholson 6B., le bleu soluble BLSE, le bleu coton C4B, from the house of Poirrier et Dalsace at St. Denis; le bleu brillant verdâtre pour coton, le bleu papier V. from Bayer et Cie at Flers near Roubaix; les bleus alcalins 6B, bleus nouveaux, G et R, from L. Cassella, Lyons; bleu de Bayer DBF, from Badische Analine Soda Fabrik, Neuville sur-Saône. These colors are soluble in water. They stain protoplasm a deep blue and callose a greenish blue; also lignin slightly. They do not stain cellulose. (3) For pectin compounds:

* Kaliumhypochlorite.

he azo acid browns, such as the Bismarck browns (Vesuvin, brun d'aniine). These do not stain cellulose or callose. (4) For protoplasm, lignin, nd cutin: The acid browns of variable composition, often having no elation to Bismarck browns. These are salts of soda of which the colring matter is the base. They are soluble in water. They stain protolasm brown, and certain stain cellulose rose color, but feebly. They olor lignin and cutin deeply in an acid bath. They do not stain pectin r callose compounds. They also mix with the soluble blues without recipitation and consequently are very suitable for the preparation of louble stains, by means of which callose can be distinguished very eadily in the midst of tissues rich in nitrogenous matters—ERWIN F. SMITH.

PECK, CHARLES H.—*Annual Report of the State Botanist of the State of New York.* Forty-fourth Rept. N. Y. State Mus. Nat. History: Albany, 1891, pp. 75, pl. 4.

The above was distributed to botanists during December, 1891, and is the most extensive contribution to systematic mycology issued during the year in this country. Prof. Peck continues his observations on fungi and gives descriptions of many new species, some of which are illustrated. In speaking of the liability of plants to the attacks of fungi, he says that certain species of spruce trees in a starved and unthrifty condition were attacked by *Peridermium decolorans*, while those in a healthy condition were exempt. The New York species of *Tricholoma* are monographed in a manner similar to genera in previous reports, forty-seven species being described. There is also given a notice of a manuscript volume by Mary E. Banning, which contains descriptions of some new species. The figures are colored by hand, and all the species were collected in Maryland. They are mostly Hymenomycetes and Gastromycetes. Fourteen new species are described.

The following is the contents of the report: (A) Plants added to the herbarium, including many species of fungi (pp. 9–11). (B) Contributors and their contributions (pp. 11–14). (C) Species of plants not before reported (pp. 15–30), with the following new species: *Armillaria viscidipes*, *Tricholoma grande*, *Clitocybe fuscipes*, *Collybia expallens*, *Omphalia corticola*, *Pleurotus pubescens*, *P. campanulatus*, *Flammula squalida*, *Crepidotus distans*, *Cortinarius albidus*, *Dædalea sulphurella*, *D. extensa*, *Hydnum arachnoideum*, *Odontea tenuis*, *Mucronella minutissima*, *Thelephora odorifera*, *Cyphella arachnoidea*, *Phyllosticta ludwigiæ*, *Dothiorella celtidis*, *Diplodia liriodendri*, *D. multicarpa*, *Septoria pteridis*, *Septomyxa carpini*, *Aspergillus aviarius* (found in the visceral cavity of a canary and supposed to have caused its death), *Sporotrichum Lecanii*, *Diplosporium breve*, *Ramularia destruens*, *R. junci*, *R. graminicola*, *Cercosporella veratri*, *Bispora effusa*, *Septonema episphæricum*, *Caryospora minor*, *Metasphæria nuda*, *Pseudopeziza pyri*, *Saccharomyces betulæ*, Pk. & Pat. (D) Remarks and observations (pp. 30–38) including

remarks on fungi and descriptions of new varieties and one new species as follows: *Pleurotus atrocæruleus*, var. *griseus*, *Coniophora puteana*, var. *tubuculosa* and *rimosa*, *Vibrissea truncorum*, var. *alpipes*, *Agaricus campestris*, var. *griseus*, *Armillaria mellea*, var. *radicola*, and *Tricholoma maculatescens*. On page 36, under *Fusicladium destruens* it is noted that the presence of this species and others is a consequence, and not the cause of the death of oat plants. (E) (pp. 38–64). New York species of Tricholoma, giving keys, and descriptive notes. (F) (pp. 64–75.) Fungi of Maryland, with descriptions of new species by Mary E. Banning as follows: *Amanita pellucidula*, *Tricholoma rancidulum*. *T. edurum; T. subdurum. T. magnum*, *Clitocyle aquatica*, *Collybia siticulosa*, *C. subrigua*, *Pholita rubecula*, *P. mollicula*, *Hypholoma subaquilum*. *Coprinus virgineus*, *Russula viridipes*, *Boletus ignoratus* and *Hydnum cæspitosum*.

The plates accompanying the report are about up to the usual standard, but are not what might be expected from a rich State like New York. They would, too, have been rendered much more convenient for use had there been some indication given as to the page where the figured species is described. As there is no index one must look through the whole of the text to find the description of any desired figure.—JOSEPH F. JAMES.

SOLMS-LAUBACH, H. GRAF ZU. *Fossil Botany, being an introduction to Palæophytology from the standpoint of the botanist.* English translation by Garnsey. Revised by Balfour. Oxford: Clarendon Press, 1891, pp. 401.

This book concerns itself only with the remains of ancient plants, *i. e.*, with little or nothing more recent than genera dating from the Carboniferous era, and not at all with Dicotelydons. A part of one page only is devoted to fungi, and the statements are so concise and comprehensive that they may be quoted in full:

"Schimper gives us a long list of fungi and lichens which have been described by older writers. Where these are not merely spots on leaves, but actual Pyrenomycetes, Discomycetes, and Basidiomycetes growing on leaves or pieces of fossil wood, they still have no value except in showing what was probable without them, namely, that fungi formed a part of the ancient floras. When Polyporei and Lenzites occur, as in the brown coals, it is not surprising that we should also find silicified woods which have been half destroyed by their mycelia. Such mycelia from the wood of the Tertiary have been described by Unger under the name of Nyctomyces. That there were fungi in the older formations also is proved by the fragments of thallus with local bladder-like swellings which are occasionally found in the tissue of stems of Lepidodendron, and which have been figured by Williamson under the name of Peronosporites antiquarius, Worth. Smith. Similar objects have been mentioned by other writers also—for example, by Renault and Bertrand under the name of Grilletia sphærospermii—from seeds of the period of the coal measures found in the siliceous fragments of Grand Croix. A form described by Ludwig from coal seams in the Urals as Gasteromyces farinosus may be nothing more than an aggregate of spores and spore tetrads of some archegoniate plant. That bacteria destroyed the substance of dead plants during the period of the Coal measures, as they do at the present day, is rendered extremely probable by the researches of Van Tieghem, who has

shown that the macerated vegetable fragments in the pebbles of Grand Croix exhibited the same progressive demolition of cell wall which is observed in modern cases. Van Tieghem even believes he has seen his Bacillus Amylobacter in a silicified state."—ERWIN F. SMITH.

VIALA, PIERRE. *Monographie du Pourridie des Vignes et des Arbres fruitiers.* Montpellier, 1891, pp. 121, pl. 7.

This monograph constitutes a thesis presented to the Paris Faculty of Sciences by Mons. Pierre Viala for a doctor's degree. It comprises the results of eight years work, and shows important additions to the status of the subject as recorded in the article on Pourridie in "*Maladies de la Vigne.*"

The thesis is divided into three parts. The first is historical, and treats briefly the relation of *Agaricus melleus*, *Vibrissea hypogæa*, *Fibrillaria* and *Dematophora* to Pourridie. The second part is confined to the last of these, which the author considers the principle cause of Pourridie. *Dematophora necatrix* is a species chosen for investigation, because, with the exception of a few sandy places, this is the only species of Dematophora found on vines attacked by Pourridie.

The parasitic and saprophytic nature of the fungus is fully discussed. The former has been fully proven by experiments, but is exhibited only by certain forms of the mycelium, the fruit being never produced until the host is killed.

Five forms of mycelium are distinguished—a white flocculent mycelium, a brown mycelium, root-like cords, *Rhizomorpha fragilis*, var. *subterranea*, *Rhizomorpha fragilis*, var. *subcorticalis*, and an internal mycelium. The Rhizomorpha forms agree externally with those bearing the same name, but belonging to *Agaricus melleus*, but the specific differences are carefully pointed out.

The fruiting forms are as numerous as those of the mycelium; they are chlamydospores, sclerotia, conidia, pycnidia, and perithecia. The two latter forms are here described for the first time, and, judging from what is known of other fungi, they complete the life history of the parasite. The development of these hitherto unknown forms was obtained by a special variation of the conditions under which the artificial cultures were made. Under the most favorable circumstances the pycnidia require from one year to a year and a half from the sowing of the spores to arrive at maturity; and the perithecia two years and a half.

The author has made many valuable experiments to ascertain the vitality of the fungus, the proper conditions for its development, and its resistance to fungicides. These are of especial economic importance. Much space is given to a detailed morphological description of all the forms of the fungus, especially of the mycelium.

A description of *Dematophora glomerata* is also included in the second part of the thesis. The mycelium, sclerotia, pycnidia, and conidiophores are described. The third part includes descriptions of the following forms which are often confused with Pourridie. *Fibrillaria*

(*Psathyrella*) *ampelina*, *Speira densa*, n. sp., *S. dematophoræ*, n. sp., and *Cryptocoryneum aureum*, n. sp.—EFFIE A. SOUTHWORTH.

WARD, H. MARSHALL. *Croonian Lecture: On some Relations between Host and Parasite in certain Epidemic Diseases of Plants.* Rec. February 27, 1890. Proc. Royal Society, London, vol. 47, No. 291, pp. 393–443, figs. 15.*

The study of plant diseases has shown rapid progress during the past decade and disciples of this branch of botany have reason to hope for still greater progress in the near future. Few, however, would have supposed that a work of the scope and value of the one before us would be possible at the present day. Prof. Ward has long been justly famed both for his successes in original investigations and for his happy faculty in expressing his results in the most lucid English. In the present lecture the author treats one of the most difficult, and at the same time one of the most important, subjects in the range of vegetable pathology. The introduction deals with the general subject of the relations existing between host and parasite. The author shows the close connection of normal life processes (physiological) and the abnormal ones (pathological), and insists that students in each branch must know what those in the other are doing. Then the behavior of the normal tissues is taken up and the fundamental processes going on in living cells are sketched.

The next section is concerned with the death of the cell, the author concluding with the following paragraph:

> Between the normal life, *i. e.*, the condition of affairs where the life processes are going on actively, and the state of permanent death, then, there are all possible gradations; many of these gradations coincide with the phenomena of disease—pathological conditions—and it is toward this difficult domain that I have now to carry the discussion.

Then the variations in environment as effecting the physiological processes in the host are considered, and the consequences of variations in temperature, in intensity of light, in the amount of aqeuous vapor in the atmosphere, etc., are shown. What is of special interest to workers in plant diseases is that the effects of these variations as predisposing causes to certain diseases are explained. The case is considered of a herbaceous plant growing in midsummer, which has previously been well supplied with heat and light. Then suddenly cold, dark, rainy weather sets in, and as a net result the parenchymatous tissues are particularly tender and watery, the cell walls thin and soft, the protoplasm more permeable and less resistant; the cell sap contains a larger amount than usual of organic acids, glucose, and soluble nitrogenous materials.

After rapidly sketching the state of our knowledge of the species of *Botrytis* which may under some circumstances cause widespread epidemics

* The number containing the article can be obtained from Harrison & Sons, 45-46 St. Martin's Lane, London, W. C., England, for 1 shilling 6 pence.

among plants, the author shows that these fungi must have a somewhat acid medium to grow upon; yet they require a sugar of some kind, preferably glucose, and asparagin or peptone may be advantageously offered as soluble nitrogenous foods. It is also true of these fungi that their optimum temperature for oxygen respiration is considerably lower than for higher plants, and unlike them, they require no light for their healthy growth. Dull, damp weather and a saturated atmosphere, so injurious to higher plants if long continued, decidedly favor the growth of fungi.

"Consequently," he says, "the very set of external circumstances which make the host-plant least able to withstand the entry and devastation of a parasitic fungus like *Botrytis*, at the same time favor the development of the fungus itself."

A number of examples are given of epidemic diseases caused by *Botrytis* both artificially induced and occurring in nature. Of the latter the lily disease so destructive in England during the very wet, cold, and dull summer of 1888 is given as an example. Prof. Ward has already published a full account of this epidemic in the Annals of Botany, Vol. 2, 1888, pp. 319–376.

The peculiar fact that the conidia of *Botrytis* on germinating produce germ tubes unable to penetrate living plant tissues is noted as well as the remarkable discovery that successive generations of parasitically or semi-parasitically nourished *Botrytis* acquire different powers of infection, becoming each time more powerful in the cases studied.

The last section of the lecture contains a summary of the factors of an epidemic, and this is of such general interest that it is quoted here in full.

It will be clear from the foregoing that in the case of an epidemic fungus disease, such as we have been considering, there are several classes of factors to be regarded, and I may sum up the chief points somewhat as follows: First, we have the normal healthy host-plant, with all its hereditary (internal) and adaptive peculiarities; secondly, we have the parasitic fungus, also with its disposition. Then we find, thirdly, that, apart from its inherent powers of variation, the host is subject to variable external influences during its life, which may produce such changes in the cell-walls and contents, &c., that the plant approaches nearer and nearer the limits of health, wide as we may regard these. On the other hand, we have, as a fourth consideration, the parasite also varying under the influence of changes in the factors of the environment, and its variations may, of course, be also dangerous to its welfare, but they may, on the contrary, be in such directions that it is enabled to profit by the counter-variations of the host. When the combined efforts of the physical environment are unfavorable to the host, but not so or are even favorable to the parasite, we find the disease assuming a more or less pronounced epidemic character.

It is not pretended that we have here a totally new idea, because it has long been known that some organisms which bring about parasitic diseases do vary in the intensity of their effects, and can be made to do so artificially, and we know that some of the most brilliant results in biology have been obtained in connection with certain lower organisms; but I have simply sought to show some of the links in the chain of causes and effects in the definite case of certain epidemic diseases of plants produced by the parasitism of some of the more highly developed fungi, and this, I think, has not

been done before. If the preceding argument is admissible, new light will be thrown not only on the cases of parasitism referred to, but also on the behavior of the [host] in its struggle for existence with the factors of the inorganic environment, generally.

Finally, the bearing of the discussion on other parasitic diseases is considered, and short but very suggestive paragraphs are given to a number of fungi causing diseases; among them *Phytophthora infestans*, Nectrias and wood destroying Hymenomycetes, the Ustilagineæ and Uredineæ. Copious footnotes add to the value of the paper, which should be in the hands of every student of plant diseases.—W. T. SWINGLE.

INDEX TO LITERATURE.

In the following index all articles from foreign sources are indicated by the numbers prefixed being in heavy-faced type. All those with the ordinary type relate to American literature.

A.—WORKS OF A GENERAL NATURE.

331. ATKINSON, GEORGE F. **The botanical section of the American Association of Agricultural Colleges and Experiment Stations, Washington meeting.** Bot. Gazette, vol. 16, Sept. 15, 1891, pp. 264–267. A notice of papers read before the Association in August, 1891. Refers to paper by Alwood on "A fungous disease upon apple leaves:" Garman, "A bacterial disease of cabbages:" Discussed by Alwood, Atkinson, and Halsted. Brunk on "Treatment of *Cladosporium fulvum*;" Atkinson on "Fungous diseases of the cotton plant," (exhibition of drawings); Pammel on "A destructive disease of the cherry;" Halsted on "Notes upon *Monilia fructigena* and spore germination." (See Nos. 389, 409, 430, and 542.) (J. F. J.)

332. BRANDEGEE, T. S. **Harvey Wilson Harkness.** Zoë, vol. 2, No. 1, San Francisco, April, 1891, pp. 1–2, pl. 1. A short biographical sketch with portrait. (D. G. F.)

333. BRIOSCHI, F. **Relazione del Presidente.** Atti Reale Acad. Lincei, 4ª ser., vol. 7, Rome, 1891, fasc. 11, adunanza solane d. 7 giugno, pp. 489–495. On pp. 492, 493, mentions the awarding of half a prize of 10,000 lire to Saccardo for his work "Sylloge fungorum omnium hucusque Cognitorum" with a mention of its scope and usefulness. (W. T. S.)

334. COOKE, M. C. **Confessions of a Mycophagist.** Grevillea, vol. 19, No. 91, London, March, 1891, pp. 67–71. Contains remarks on fungous forays and edible fungi; an account of the manner in which the author became a student of the fungi, and a plan for making colored sketches of Agarics. (M. B. W.)

335. GALLOWAY, B. T. **The parasitic enemies of cultivated plants.** The Chautauquan, vol. 14, No. 3, Meadville, Pa., Dec., 1891, pp. 297–302. Gives in popular language a discussion of the nature and causes of plant diseases with an account of the recent advances in the region of economic mycology, special reference being given to the advances made in the use of copper compounds as fungicides. (D. G. F.)

336. [? MASTERS, M. T.] **Mushrooms and their culture** (by C. Brooks). Gard. Chron., 3d ser., vol. 10, No. 253, London, Oct. 31, 1891, p. 518, $\frac{1}{8}$ col. Review. The author states that the work is full of misstatements, erroneous ideas, and bad English. (M. B. W.)

337. [? MASTERS, M. T.] **Mushrooms at the Chicago Exhibition** (by C. Brooks). Gard. Chron., 3d ser., vol. 10, No. 258, London, Dec. 5, 1891, p. 676, $\frac{1}{10}$ col. Notes that casts of the edible mushrooms of the U. S. are to be exhibited. (M. B. W.)

338. [? MASTERS, M. T.] **Plant diseases.** Gard. Chron., 3d ser., vol. 10, No. 256, London, Nov. 21, 1891, p. 617, $\frac{1}{4}$ col. Commends the Journal of Mycology, and suggests that an organization for the investigation of fungous diseases of plants would advance matters in England. (M. B. W.)

339. PRAIN, D. **A list of Diamond Island plants.** Jour. Asiatic Soc. Bengal, new ser., vol. 59, Bengal, 1890 (Mar. 14, 1891), pp. 271-294. Mentions four species of fungi (p. 285) found on the island, all occurring on dead wood. (J. F. J.)

340. SOLMS-LAUBACH. **Fossil botany, being an introduction to Paleophytology from the standpoint of the botanist; translated by Henry E. F. Garnsey; revised by I. B. Balfour.** Clarendon Press, 8vo, Oxford, 1891, pp. 401, many figs. See review, p. 148. (E. F. S.).

341. WHITEHEAD, CHAS. **Methods of preventing and checking the attacks of insects and fungi.** Jour. Roy. Agric. Soc., 3d ser., vol. 2, London, June 30, 1891, pp. 2[illegible]-256, figs. 26. A comprehensive paper mentioning many of the fungous diseases of plants, with history and treatment, formulæ for fungicides, and figures of machines for their application. The subject is presented under four heads, viz: Corn crops, root and vegetable crops, fruit crops, and hops. Attention is about equally divided between fungi and insects. (M. B. W.)

B.—DISEASES OF NONPARASITIC OR UNCERTAIN ORIGIN.

342. ALWOOD, W. B. **Diseases of plants.** Southern Planter, 52d year, No. 10, Richmond, Oct., 1891, pp. 552-553. Remarks presence in Virginia of peach yellows, where it has laid waste a large portion of the best peach-growing region of the State. Refers to inquiries from California in regard to Virginia nursery stock. Author has not seen the yellows in the nurseries. Notices presence of black rot of grapes controllable by weak formula of Bordeaux mixture and calls attention to presence of leaf spot of the apple distinct from the apple rust caused by *Ræstelia*. (D. G. F.)

343. BAILEY, L. H. **Peach yellows.** Cornell Univ. Agric. Ex. Sta., Bull. 25, Ithaca, Dec., 1890, pp. 178-179. Notes presence and spreading of yellows in New York State; also work of Dr. Erwin F. Smith in Maryland. (D. G. F.)

344. C[OLLINS], A. L. **Causes of die back.** Fla. Disp., Farmer and Fruit Grower, new ser., vol. 3, No. 8, Jacksonville, Feb. 19, 1891, p. 143. Discusses cause of die back in oranges. Thinks due to overstimulation by nitrates. (D. G. F.)

345. GALLOWAY, B. T. **La Maladié de la vigne en Californié.** [The vine disease of California.] Progres Agricole et Viticole, 8 Ann., No. 48, Montpellier, Nov. 29, 1891, pp. 509-512. Gives brief notice of the work of the special agent, Mr. Pierce, on the California vine disease, as given in his preliminary report, not yet published. (J. F. J.)

346. GOETHE, R. **Eisenvitriol als Heilmittel der Gelbsucht der Obstbäume.** Bericht K. Lehranstalt für Obst und Weinbau, Jahrg. 1889-1890, Wiesbaden, 1891, p. 30-31. Reviews Sachs's work on the treatment of chlorotic plants. Tried experiments with iron sulphate on several varieties of fruit trees with very favorable results. One kg. of iron sulphate was used for smaller trees, 2 kg. for larger. Mentions certain varieties of pear and apple which need more iron and consequently are more subject to disease. Treated trees were less attacked in some cases by the leaf *Aphis* and *Schizoneura*. (W. T. S.)

347. GILLETT, M. E. **Sour stocks the only preventive of foot rot.** Fla. Disp., Farmer and Fruit Grower, new ser., vol. 3, No. 44, Jacksonville, Oct. 29, 1891, p. 871. Reports doubtfully the successful use of sour stocks as a preventive of the foot rot. (D. G. F.)

348. HART, W. S. **American Pomological Society meeting in Washington, Sept. 22, 23 and 24, 1891.** Fla. Disp., Farmer and Fruit Grower, new ser., vol. 3, No. 40, Oct. 1, 1891, pp. 783-784. Notes on method of exposure of roots and washing of same as a cure for the Mal di Goma or foot rot. Also petition of secretary of Interlachen Hort. Society, that agent of U. S. Department of Agriculture be sent to investigate the orange diseases of Florida. (D. G. F.)

349. HART, W. S. **Foot rot does attack sour stocks.** Fla. Disp., Farmer and Fruit Grower, new ser., vol. 3, No. 45, Nov. 5, 1891, p. 891, 2 cols. Discusses in popular language the foot rot of oranges, claiming the disease is present on sour stock,

although sour stocks are more resistant than sweet stocks. Thinks no remedy has been found for the disease, although exposure and washing of roots has seemed to give good results. (D. G. F.)

350. HEIMERL, Dr. ANTON. **Zur Beseitigung der Chlorose.** Wiener illust., Garten-Zeit., 16 Jahr., Wien, August–Sept., 8 n. 9 heft 1891, pp. 331–335. Pale leaves may be due to three causes: (1) lack of light, etiolation; (2) lack of heat; (3) lack of iron. Author speaks especially of the pale leaves due to the last mentioned cause, giving a résumé of the work of Sachs on the subject. Quotes from Sachs the method of treatment: 2–3 or even 6–8 kilograms of iron sulphate is mixed with earth in ditches radiating from the tree between the principal roots or encircling the tree at a distance of 5–10 decimeters from the trunk. Then the tree is liberally watered with 100–150 liters of water. Plants in pots may be immersed in a weak solution of iron sulphate. Explains the rather large quantity of iron sulphate required to take effect on large plants in part by the absorptive action of the soil, in part by the weakening of the power of the plant to absorb it. (W. T. S.)

351. HEWETT, C. B. **Trees, bugs, and disease.** Rural California, vol. 14, Los Angeles, Dec., 1891, p. 727, one-third col. States belief that as peach yellows thrives in a damp and rainy climate it would not exist in the dry air of California. "I believe that if a tree affected by the yellows could be taken up and transplanted from an orchard in the East to our soil and climate that unless too far gone it would revive and get over it entirely." (J. F. J.)

352. JACKSON, J. F. **Peach yellows.** Southern Planter, 51st year, No. 2, Richmond, Feb., 1890, pp. 60–61, one-fourth col. Notes the introduction of peach yellows bill into the Virginia State legislature. (D. G. F.)

353. KING, WM. R. **Mal di Goma.** Bull. U. S. Dept. of Agric., Div. of Pomology, No. 4, Washington, Feb., 1891, pp. 18–19. Describes characteristics of the disease; considers cause as not certainly known, but seemingly of possible bacterial origin; as certainly contagious by use of infected instruments. Recommends as preventive measures: (1) Budding on resistant stocks—wild sour orange, rough lemon or pomelo; (2) planting on dry porous soil if sweet stock be used; (3) careful irrigation, keeping the water from the trunk of the tree; (4) prompt removal and destruction of diseased portions. Quotes from Lelong recommending mixture of 1 peck fresh lime, 4 pounds of copperas, 5 pounds sulphur, mixed in enough water to slake the lime, and keep covered as a good disinfectant paint. (See also Rural Californian, vol. 14, Dec., 1891, p. 718; Fla. Disp., Farmer and Fruit Grower, new ser., vol. 3, June 18, 1891, p. 495.) (D. G. F.)

354. LELONG, B. M. **Peach yellows.** Pacific Rural Press, vol. 42, San Francisco, Oct. 10, 1891, pp. 301, 312, pl. 1, map 1. Describes the yellows as it appears in New Castle County, Del., quoting from Bulletin No. 9, Div. Veg. Pathology, and giving plate from same bulletin, and enlarged map of distribution of yellows and rosette in the United States, prepared with aid of Galloway and Smith. An appeal to fruit growers to guard against introduction of disease into California through purchase from unreliable nurseries. (D. G. F.)

355. LELONG, B. M. **Peach yellows. A warning to fruit growers. Danger of introduction into California. Warning to intending purchasers and recommendation.** Cal. State Board of Hort., Sacramento, 1891, pp. 25, pl. 4, 1 map. Discusses the dangers of introduction of disease into California. Gives map showing extent of the disease, extracts from correspondence with large number of eastern horticulturists. Quotes from work by Dr. Erwin F. Smith and proposed ordinance passed by the county board of horticultural commissioners of San Bernardino County. Gives copies of horticultural laws of California and peach yellows laws of Michigan and New York. (D. G. F.)

356. LOS ANGELES EXPRESS. **A risky experiment.** Rural Californian, vol. 14, Los Angeles, Dec., 1891, p. 753, one-fourth col. Refers to statement of theory

that peach yellows will not thrive in California. Argues that stock should not be imported from infected regions and that home grown, *i. e.*, California stock, should alone be used. (J. F. J.)

357. LUGGER, OTTO. **Disease of flax.** Biennial Rep. Minn. Agric. Ex. Sta., ending Dec., 1890, Minneapolis, 1891, p. 19. Notes destructive disease of flax near Windom, Minn., and promises further report upon experiments in its prevention. Noted as a contagious disease, but cause not given. (D. G. F.)

358. MANVILLE, A. H. **Will foot rot attack the sour stock?** Fla. Disp., Farmer and Fruit-Grower, new ser., vol. 3, No. 41 Jacksonville, Oct. 8, 1891, pp. 803–804, 1 col. Expresses doubt as to occurrence of the foot rot of oranges upon sour stocks. (See also Rural Californian, vol. 14, Dec. 1891, p. 724.) (D. G. F.)

359. [?MASTERS, M. T.] **Cucumber disease.** Gard. Chron., 3d ser., vol. 10, London, July 18, 1891, p. 75, $\frac{1}{10}$ col. Notes receipt of specimens of diseased cucumbers with nodules on roots. (M. B. W.)

360. [?MASTERS, M. T.] **Peach yellows.** Gard. Chron., 3d ser., vol. 9, London, Feb. 28, 1891, p. 274, $\frac{1}{6}$ col. Notes the receipt of specimens of peach yellows from the Cape of Good Hope, and states that the disease is unknown in England. (M. B. W.)

361. [?MASTERS, M. T.] **Tomato diseases.** Gard. Chron., 3d ser., vol. 9, London, May 9, 1891, p. 593, $\frac{1}{4}$ col. Notes the receipt of diseased tomato plants, in which neither insects nor fungi could be found, with description of external characters. (M. B. W.)

362. MAYET, VALERY. **Rapport sur une maladie affectant les citronniers dans l'arrondissement de Calvi.** Ministère de l'agric. Bull., 1891, No. 5, 10th yr., Paris, Oct., 1891, pp. 449–456. Contains an interesting account of gummosis or foot-rot of citron trees in the north part of Corsica. The disease is thought to be the same as one which formerly attacked orange trees in S. E. France, Italy, and Portugal, and analogous to a disease of pomaceous trees in Normandy, reported on by Van Tieghem, in Ann. Soc. Bot. de Fr., 1879. It is believed to be of nonparasitic origin and due to a series of rainy seasons, to excessive irrigation, or to any other cause which, by depriving the roots of air, compel them to derive oxygen from stored sugar with the formation in the tissues of alcohol and CO^2 and the series of symptoms described. In other words the disease is ascribed to asphyxia of the roots, and may be called "pouridie without fungi." It has done great injury in Corsica. (E. F. S.)

363. RHIND, DUNCAN. **Peach yellows and its remedy.** Cult. and Country Gent., 61st year, No. 2027, Albany, Dec. 10, 1891, pp. 996–997, 1 col. States belief that disease is caused by overcropping, combined with excess of moisture, growing varieties not hardy, and growing late varieties that can not properly ripen wood. Advocates grafting on hardy stock, such as plum and almond. Believes disease to be due to impaired vitality, and must be treated by each orchardist for himself according to circumstances. (J. F. J.)

364. RURAL CALIFORNIAN. **Bugs and diseases.** Rural Californian, vol. 14, Los Angeles, Dec., 1891, p. 727, $\frac{1}{4}$ col. Quotes resolutions adopted by convention of fruit-growers in Marysville, Cal., against importation of nursery stock, peach, apricot, etc., from regions infected with "yellows." (J. F. J.)

365. RURAL CALIFORNIAN. **[Peach yellows in Connecticut].** Rural Californian, vol. 14, Los Angeles, Dec., 1891, p. 723, $\frac{1}{8}$ col. Refers to presence of yellows in Connecticut and notes recommendation to destroy all trees affected with the disease. (J. F. J.)

366. SCIENTIFIC AMERICAN. **Peach yellows.** Scientific American, vol. 65, New York, Sept. 26, 1891, p. 194, $\frac{1}{4}$ col. Quotation from New England Farmer referring to belief that the disease is a symptom of starvation, and can be cured by potash and nitrate of soda, 10 pounds of the former to 5 of latter. Also notes the belief by M. P. Augur that disease is caused by microscopic germs. Refers to work of Erwin F. Smith. (J. F. J.)

367. SMITH, ERWIN F. **Additional evidence on the communicability of peach yellows and peach rosette.** Bull. U. S. Dept. of Agric., Div. Veg. Path., No. 1, Washington [Dec.], 1891, pp. 65, pl. 39. Comprises the author's investigations, covering a period of three years, into the nature and communicability of peach yellows, and the characterization of a new disease of the peach in Georgia and Kansas. Gives series of inoculation experiments with the yellows conducted in Maryland, together with 50 excision experiments in seven different orchards, which, in connection with a series of experiments bearing upon immunity of the disease, warrant the author in drawing the following conclusions: (1) That the disease is contagious; (2) that it may be conveyed by seemingly healthy buds when these are taken from diseased trees; (3) that only a very small quantity of infectious material is necessary, provided it be in the form of living cells which can be induced to unite with the actively growing tissue of the tree; (4) that the disease has a longer period of incubation than has been customary to suppose; (5) that the death of the entire tree occurs, ordinarily, only after a very considerable period, *i. e.*, several years. The peach rosette, upon which a most successful series of bud inoculation experiments is reported, is found to differ from the yellows in eight characteristic features. The author's experiments with buds taken from wholly diseased trees and from the healthy side of a diseased tree resulted in transmission of the disease in the former case, and healthy growths in the latter. The author concludes in regard to this remarkable disease: (1) That it is virulently contagious; (2) that it may exist for a short time in a part of the tree without being present in the rest; (3) that it has gained a strong foothold in Georgia and is on the increase; (4) that the necessity for prompt concerted action on the part of Georgia peach-growers by removal of all diseased trees is very great. (D. G. F.)

368. SMITH, ERWIN F. **Chemistry of peach yellows.** Cult. and Country Gent., vol. 56, No. 2021, Albany, Oct. 22, 1891, p. 859, ½ col. Short abstract of paper read before the 23d biennial meeting of the American Pomological Society. Reported by T. G. R., giving a few results of treatment by fertilizers. (D. G. F.)

369. SMITH, J. H. **A disease of lime trees.** Fla. Disp., Farmer and Fruit-Grower, new ser., vol. 3, No. 42, Jacksonville, Oct. 15, 1891, p. 827, ½ col. Notes a peculiar disease causing blossoms to fall in spring and leaves to become knotty. (D. G. F.)

370. WIESTER, W. H. **Apricot disease.** Pacific Rural Press, vol. 42, San Francisco, July 11, 1891, p. 28, ½ col. Gives complaint of apricot disease known as die-back, said by editor to be "an old complaint." (D. G. F.)

(See also Nos. 411, 412, 433, 470, and 507.)

C.—DISEASES DUE TO FUNGI, BACTERIA, AND MYXOMYCETES.

A.—RELATIONS OF HOST AND PARASITE.

371. DANGEARD, P. A. **Note sur les Mycorrhizes Endotrophiques.** Le Botaniste, 2ᵉ ser., 5ᵉ fasc., Paris, May 1, 1891, pp. 223–228, figs. 8. Discusses in more or less general way symbiotic action of fungi and roots of phanerogams, and describes the presence of a species of endotropic Chytridiaceæ, *Cladochytrium tmesipterides* n. sp., which the author concludes is probably parasitic in the rhizomes of *Tmesipteris viellardi*, although in some respects apparently in symbiotic relations with the host. A second species of *Mycorrhiza* found growing upon the same rhizomes the author believes is probably identical with either Wahrlichs' *Nectria goroshaukiniana* or *N. vandæ*. He is disposed to consider this latter species together with a third fungus found in connection, the name of which is not given, as being of use to the plant. The study is made from herbarum specimens only. (D. G. F.)

372. HEIMERL, DR. ANTON. **Ueber Symbiose. Vortrag, gehalten am 6 März, 1891 in der k. k. gartenbau Gesellschaft.** Wiener illust. Gart. Zeit., 16 Jahr., Wien, April, 1891, pp. 138–146. Mentions in course of a popular lecture *Mycorrhiza* and the *Rhizobium leguminosarum* in root tubercles of Leguminosæ. Gives a résumé of recent work on the absorption of free nitrogen by Leguminosæ and discusses the part played by the fungus in the act. (W. T. S).

373. LYON, W. S. **Damping off.** Garden and Forest, vol. 4, No. 199, New York, Dec. 16, 1891, p. 599, ½ col. Refers to statement frequently made that disease germs are on the seeds, but says he was unable to find any. Considers the pulverizing of the soil and then sprinkling to be especially favorable to spread of disease. Concludes the disease germs are in the soil, as contended by Halsted. (J. F. J.)

374. [? MASTERS, M. T.] **Parasitic fungi in relation to plant diseases.** Gard. Chron., 3d ser., vol. 9, London, Feb. 14, 1891, p. 211, ¼ col. Syllabus of three lectures to be delivered by C. B. Plowright before the Royal College of Surgeons, England. (See also *Ibid.*, Jan. 24, 1891, p. 114.) (M. B. W.)

375. [? MASTERS, M. T.] **Parasitism in plants.** Gard. Chron., 3d ser., vol. 9, London, May 16, 1891, p. 620, ½ col. Notes a lecture given by Prof. H. Marshall Ward in the Royal Botanic Gardens, on "Problems of Parasitism in Plants." (M. B. W.)

376. RÁTHAY, EMERICH. **Ueber myrmekophile eichengallen.** Botanisches Centralbl. Bd., 49 No. 1, 13 Jahrg., Cassel, 9 Jan., 1892, pp. 12–13. A notice in Originalbericht gelehrter gesellschaften. k. k. zool. bot. Gesell. in Wien. Mentions a theory of Delpino that the spermogonia of certain rust fungi by attracting ants and other pugnacious insects, protect those leaves on which they occur, so that they may live to produce the Æcidia. (W. T. S.)

377. RUSH, W. H. **Penetration of the host by Peronospora gangliformis.** Bot. Gazette, vol. 16, No. 7, July, 1891, pp. 208–209, fig. 1. Figures penetration of stomata of *Lactuca sativa* by germ hyphæ of conidia of *Peronospora gangliformis*; finds no case of penetration of epidermal cells, contrary to de Bary's observation. (D. G. F.)

378. VUILLEMIN, PAUL. **Sur les effets du parasitisme de l'Ustilago antherarum.** Comptes Rendus, vol. 113, Paris, Nov. 9, 1891, pp. 662–665. It is well known that the pistillate flowers of *Lychnis dioica* take the appearance of hermaphrodites when invaded by this fungus. It was formerly supposed that when any flowers of a plant were attacked all were. The author shows that such is not the case. The flowers of a single branch may be invaded, while those of a neighboring one may escape. The base and lower branches may escape, while all the flowers in the top of the plant are affected. In other cases some small branches may be affected, among which the stem pushes out sound branches. Such partial attacks are common. The action of the parasite stimulates the development of the normally abortive stamens and the smut spores take the place of pollen grains and escape, and are distributed in the same way. The author thinks there is a symbiosis analogous to that in galls. He has found the stigmas of isolated and healthy plants powdered with spores of Ustilago, which he believes were transplanted from infected plants by visiting insects. (E. F. S.)

(See also Nos. 379, 381, 428, 432, 443, and 450.)

B.—DISEASES OF FIELD AND GARDEN CROPS.

379. ARTHUR, J. C. **Wheat scab.** Bull. Purdue Univ., Agric. Ex. Sta., vol. 2, No. 36, Lafayette, Aug. 25, 1891, pp. 129–132. Records presence near Lafayette of disease of wheat probably caused by a *Fusarium* more or less nearly related to *Fusarium* (*Fusisporium*) *culmorum* of W. G. Smith. Estimates damage from the parasite at from 10 to 20 per cent. Points out fact that the late plant-

ing of wheat greatly influences amount of "scab;" that planted late, and hence blooming late being worst affected. Considers vigorous growth and early blooming the chief safeguards against the disease. (D. G. F.)

0. Bolley, H. L. **A disease of beets, identical with deep scab of potatoes.** Bull. Gov. Agric. Ex. Sta., N. Dak., No. 4, Fargo, Dec., 1891, pp. 15–17, pl. 1. Describes disease and states it seems to be the same as that affecting potatoes. Occurs also on turnips, cabbage roots, and carrots. (J. F. J.)

31. Bolley, H. L. **Notes on potato scab.** Agric. Science, vol. 5, No. 9, La Fayette. Sept., (Nov. 7,) 1891, pp. 212–214. Gives result of investigations made in Dakota, in which the fungus characterized by Thaxter is found undoubtedly genetically connected with the disease. Considers it possible that his previous year's investigation may contain errors and acknowledges the superiority of Thaxter's fungus as a scab producer. (D. G. F.)

32. Bolley, H. L. **Potato scab, and possibilities of prevention.** Bull. Gov. Agric. Ex. Sta., N. Dak., No. 4, Fargo, Dec. 1891, pp. 1–14, 21–31, pl. 1, figs. 4. Discusses nature of potato scab, giving theories in regard to cause. Considers disease due to parasitic fungi and describes effects. Gives report of experiment for prevention of disease and recommends selection of sound potatoes for seed; gives also formula for treating seed before planting, as follows: Corrosive sublimate, 2 oz., dissolve in 2 gallons of hot water and leave all night; dilute with 13 gallons of water, stir thoroughly and immerse potatoes to be used for seed in mixture for 1½ hours; dry potatoes, cut and plant as usual. In appendix to article gives table of tests of effects of character of soil on the origin of the disease, together with statement of treatment adopted for prevention. Discusses the difference between surface and deep scab, leaving the subject in doubt as to whether the diseases are distinct or different forms of the same. (J. F. J.)

83. Chester, F. D. **Notes on three new or noteworthy diseases of plants.** Bull. Torrey Bot. Club, vol. 18, Dec. 1891, pp. 371–374. Refers to and describes (1) Anthracnose of the tomato, caused by *Colletotrichum lycopersici*, n. sp. (2) A leaf spot of celery, possibly caused by a new species, in which case it might be named *Septoria apii*. (3) Blight of watermelon vines caused by *Phyllosticta citrullina*, n. sp. (J. F. J.)

84. Claypole, Katherine B. **My garden on an onion.** Pop. Sci. Monthly, vol. 39, New York, May, 1891, pp. 72–76, figs. 3. Gives account in popular language of attacks of *Penicillium glaucum* and *Polyactis* sp. upon onion bulbs. Notes parasitism of *Baryeidamia* upon *Polyactis*. (See also International Jour. Micros. and Nat. Sci., 3rd ser. vol. 1, London, Nov., 1891, pp. 329–333, pl. 1.) (D. G. F.)

85. Coquillet, D. W. **Some pests of the horticulturist.** Rural Californian, vol. 14, Los Angeles, Dec., 1891, pp. 714–715. Refers to potato blight (*Phytophthora infestans*) and states results of use of Bordeaux mixture. Gives formula and recommends its use. (J. F. J.)

386. Crawford, J. M. **Cotton growing in Russia.** Reports from consuls of the United States, No. 130, Washington, July, 1891, pp. 425–430. Refers (p. 426) to the "rust" of cotton appearing in the Erivan district in 1888 after a wet summer. The disease had never before been observed on the plant known locally as "Kara-kosa," but in some localities it destroyed nearly one-half the crop. (J. F. J.)

387. Crozier, A. A. **Potato scab.** Agric. Science, vol. 5, La Fayette, No. 9, Sept., 1891. (Nov. 7, 1891, p. 215.) Gives results obtained from planting two rows of potatoes, the one of scabby tubers and the other of healthy ones. Concludes harvest from planting of healthy tubers, though partly scabby, better than the harvest from the planting of scabby tubers. (D. G. F.)

388. GALLOWAY, B. T. **Further observations on a bacterial disease of oats.** Bot. Gaz., vol. 16, No. 9, Sept. 15, 1891, p. 257. Short notice, by editor, of paper read before Section F, A. A. A. S., Aug., 1891, at Washington, D. C., giving results of study of disease, showing ability of germ to pass the winter on seed in diseased plant, on volunteer oats, and to limited extent in soil. (D. G. F.)

389. GARMAN, H. **A bacterial disease of cabbages.** Bot. Gazette, vol. 16, No. 9, Sept. 15, 1891, p. 265. Notice of paper read before the Botanical Sec. Am. Asso. Agr. Col. and Ex. Sta., Aug., 1891, in which rotting of cabbage heads is traced to work of bacteria. (See No. 331) (D. G. F.)

390. GRIFFIN, G. W. **Australasian wheat harvest, 1890-'91.** Reports from consuls United States, No. 128, Washington, May, 1891, pp. 120-128. Refers (p. 127) to rust in wheat. A. N. Pearson, of Victoria, has been experimenting with hybrids to prevent rust, as well as improve the quality of seed in other respects. In Gippsland two varieties and at Port Fairy six varieties have escaped the disease. (J. F. J.)

391. HALSTED, B. D. **A new eggplant disease.** Bull. Torrey Bot. Club, vol. 18, No. 10, Oct., 1891, pp. 302-303. Gives paper read before the Botanical Club of the Am. Asso. Adv. Sci., Washington, Aug., 1891, describing *Phoma solani*, n. sp., as one of the damping-off fungi attacking young eggplants in the hot-bed. Gives account of successful culture of the fungus on agar and sterile portions of healthy stems. Notes in connection as injurious to eggplants *Phyllosticta hortorum*, Speg., *Botrytis fasicularis*, (Cd.) Sacc., *Gloeosporium melongenæ*, E. & Hals. Noticed in Bot. Gazette, vol. 16, Sept. 15, 1891, p. 261. (D. G. F.)

392. HALSTED, B. D. **A new Nectria.** Bot. Gazette, vol. 16, No. 9, Sept. 15, 1891, p. 257. Short notice of paper read before Section F of A. A. A. S. Aug., 1891, describing stem-rot of sweet potato as caused by a new *Nectria* related to *Nectria Vandæ*, Ward. (D. G. F.)

393. HALSTED, B. D. **Notes upon bacteria of cucurbits.** Bot. Gazette, vol. 16, Sept. 15, 1891, pp. 257, 258. Short notice of paper read before Section F of A. A. A. S., Aug., 1891, giving results of study of disease of melons, squash, and cucumber plants, caused by bacteria. (D. G. F.)

394. HUMPHREY, J. E. **Some diseases of lettuce and cucumbers.** Bull. Mass. State Agric. Ex. Sta., No. 40, Amherst, July, 1891, pp. 2-3. Gives preliminary notice of a destructive disease of lettuce caused by a species of *Polyactis* or *Botrytis* occurring in the greenhouses. Recommends clean culture as the best preventive. Notes presence of *Oidium erysiphoides*, Fries. var. *cucurbitarum*, Auch, upon hothouse cucumbers sent from Fitchburg, Mass., and Ithaca, N. Y. Recommends potassium sulphide 1 oz. in 3 gallons of water, finding 1 oz. per 2 gallons injures foliage. (D. G. F.)

396. JONES, L. R. **A new (?) oat disease.** Fourth Ann. Rept. Vt. Agric. Exper. Sta., Burlington, 1890, p. 139. Reports serious disease of young oat plants in the State, surmising from observation that it was caused by *Fusicladium destruens*, Peck. (See No. 167.) (D. G. F.)

397. JONES, L. R. **Smut on oats.** Fourth Ann. Rep. Vt. Agric. Exper. Sta., Burlington, 1890, pp. 138-139. Reports percentage of smut in experimental plots and fields in 1890 as ranging from a fraction of 1 per cent up to 23 per cent by actual count. (D. G. F.)

398. JONKMAN, Dr. H. F. **Vijanden der koffieplant.** Album der Natuur, Haarlem, 1892, pp. 1-20, 33-49. Treats of the parasites of the coffee plant, especially of *Hemileia vastatrix* and a root nematode. The leaf disease due to the former was first discovered in Ceylon about 1869, and two years later in the south part of British India. In 1877 the blight appeared to such an extent in Ceylon that the coffee product fell from 45,000 to 25,000 kilograms. Since then the product has diminished so greatly that the island can scarcely any longer

be regarded as a coffee-producing country. The disease first appeared in Sumatra in August, 1876. It was discovered in the botanic garden at Buitenzorg in March, 1879. Later it was found to have shown itself generally in Java in 1879-'80. It is not yet known definitely to occur outside of the Indian Ocean region, although a similar sort has been reported from West Africa, and a coffee-leaf disease was reported in 1890 from Central America. (E. F. S.)

399. KIRCHNER, O. **Braunfleckigkeit der Gerstenblätter.** Zeitschrift für Pflanzenkrankheiten, Bd. 1 Heft 1, Stuttgart, 1891, pp. 24-26, figs. 2. Reports the occurrence of a disease of barley caused by *Helminthosporium gramineum* (Rabenh.) Eriksson, that Eriksson had already reported from Sweden. It causes dark brown spots often over 1 cm. long visible on both sides of the leaf and surrounded by a narrow yellow margin. With the progress of the disease the spots elongate and the leaves wilt and turn yellow. Gives description of the fungus; it was found at Hohenheim, Vorarlberg and in Tirol in 1889 and in and around Hohenheim again in 1890. Did not cause serious damage in that it attacked only the lower leaves. Was not found on other cereals. (W. T. S.)

400. LEATHR, J. W. **The smut of onions.** Jour. Roy. Agric. Soc., 3rd ser., vol. 2, London, Sept. 30, 1891, pp. 647-650. Review of a paper by R. Thaxter in Annual Report of the Connecticut Agric. Ex. Sta. for 1889, giving an abstract. (See No. 10.) (M. B. W.)

402. PAMMEL, L. H. **Fungous diseases of Iowa forage plants.** Monthly review Iowa Weather and Crop Service. Separate, 1891 (?), pp. 33, figs. 15. Deals in more or less popular way, using illustrations from various authors, with the following diseases: (I) Rusts of wheat, barley, oats, Indian corn, clover and apple. (II) Smuts of Indian corn, oats, barley and wheat, with method of treatment. (III) Smuts of timothy, wild rye, tall meadow oat grass, brome grass, *Bromus breviaristatus*, *Cenchrus tribuloides*, and old witch grass (*Panicum capillare*). (IV) Mildews, *Erysiphe graminis* on various species of grass and *Peronospora graminicola* on *Setaria Italica* and *Setaria viridis; Peronospora trifoliorum* on various species of clover. (V) Ergot. Hosts affected, chemical composition, and a short history of ergotism quoting from work of various authors. (VI) Spot diseases: *Phyllacora graminis*, Pers. on *Agropyrum repens, Elymus Canadensis, Asprella hystrix, Panicum dichotomum; Phyllachora trifolii* on clover. *Phacidium medicaginis*, Lasch, on alfalfa; *Scolecotrichum graminis* on orchard grass. *Helminthosporium graminum*, Rabh., on barley. (VII) Bacterial diseases; sorghum blight, bacterial disease of corn discovered by Burrill. Notes failure of the pure culture from the diseased cornstalks to produce the cornstalk disease of cattle as announced by Billings. (D. G. F.)

403. PRILLIEUX, M. **La pourriture du Cœur de la Betterave.** Bull. Soc. Mycol. France, vol. 7, Paris, Mar. 31, 1891, pp. 15-19, figs. 3. Ascribes the heart rot of the sugar beet to a new fungus, *Phyllosticta tabifica,* which attacks the petioles of the larger leaves. Considers the dark-colored fungi on the central leaves as secondary. (E. A. S.)

404. PRILLIEUX ET DELACROIX. **A propos du Cercospora apii, parasite sur les feuilles vivantes du Celeri.** Bull. Soc. Mycol. France, vol. 7, Paris, Mar. 31, 1891, pp. 22-23. Notes the injurious presence of *Cercospora apii* in the experimental garden of the "Institute Agronomique," at Joinville-le-pont, and gives the manner of infection. (E. A. S.)

405. PRILLIEUX ET DELACROIX. **Sur une maladie des Tomatoes produite par le Cladosporium fulvum, Cooke,** Bull. Soc. Mycol. France, vol. 7, Paris, Mar. 31, 1891, pp. 19-21; figs. 3. Describes the effect and external appearance of the fungus. Notes the successful use of sulphur and unsuccessful use of Bordeaux mixture in combating it. (E. A. S.)

406. REID, JAS. A. **The potato and its blight in Ireland.** Repts. from consuls of U. S., No. 125, Feb., 1891, pp. 182–184. Refers to the destruction of potatoes by *Peronospora infestans.* Explains in a general way the life history of the fungus. The remedies suggested are: (1) Hilling up earth about stalks; (2) cutting off diseased tops; (3) removing and burning rubbish; (4) planting varieties most successful in resisting disease; (5) growing crops under conditions to insure health and vigor; (6) careful selection of seed. (J. F. J.)

407. RUSSELL, SAM'L J. **Linseed in India.** Repts. from consuls of U. S., No. 126, Mar., 1891, pp. 341–344. States (p. 342) that rust is a great enemy of the plant and it always suffers from it in damp seasons. (J. F. J.)

408. SMITH, W. G. **Tobacco disease.** Gard. Chron., 3rd ser., vol. 9, No. 216, London, Feb. 14, 1891, p. 211, ½ col., fig. 1. Notes that Prof. Farlow has stated that *Peronospora hyoscyami* has badly attacked *Nicotiana glauca* in Mexico and California. (M. B. W.)

(See also Nos. 482, 483, 484, 485, 486, 487, 489, 507, 553 and 591.)

C.—DISEASES OF FRUITS.

409. ALWOOD, WM. B. **A fungous disease upon apple leaves.** Bot. Gazette, vol. 16, No. 9, Sept. 15, 1891, p. 265. Notice of paper read before Bot. Sec. Am. Ass. of Agric. Col. and Ex. Sta., Aug. 13, 1891, giving account, without description, of species of fungous disease of apple, and successful use of weak Bordeaux in its prevention. (See No. 336.) (D. G. F.)

410. BAILEY, L. H. **Preservation of trees.** Am. Farm News, vol. 4, No. 7, Aug., 1891, p. 11, 2 cols. Gives abstract of address delivered before N. Y. State Cider and Cider-Vinegar Makers' Association at Albany, N. Y., Jan. 28, 1890 [1891?]. Discusses the failure of the fruit crop in New York State in 1890. Expresses the opinion that the failure was due largely to the action of *Fusicladium dendriticum* and gives formulæ for preparation of ammoniacal solution of copper carbonate, and modified eau celeste. (D. G. F.)

411. BEACH, JOHN B. **Lemon scab—Orange blight.** Fla. Disp., Farmer and Fruit Grower, new ser., vol. 3, No. 31, Jacksonville, July 30, 1891, p. 603, 1 col. Cites success of one spraying with sulphate of potash 50 per cent; also successful use of sulphide of lime made by boiling quicklime with flowers of sulphur as preventive of the scab. Thinks blight is advanced condition of black limb. (D. G. F.)

412. BEAN, E. **Report of committee on diseases and insects of the Citrus.** Fla. Disp., Farmer and Fruit Grower, new ser., vol. 3, No. 21, May 21, 1891, pp. 409–410. Notes the following diseases with opinions as to their causes; foot rot, leaf blight, rust, black smut and a new disease similar to that on the grapevine attacking the ends of the branches of orange trees. (D. G. F.)

413. BRUNK, T. L. **Blackberry rust.** 3d Ann. Rept. Maryland Agric. Ex. Sta., College Park, 1890, pp. 115–116. Gives estimates of per cent of rust, *Cæoma nitens,* Schw., on 20 varieties of blackberries growing on station farm. Concludes Wilson's early, Wilson's junior, Wachusett, early harvest, crystal white, and Thompson's early mammoth as least susceptible to the disease. (D. G. F.)

414. BRUNK, T. L. **Strawberries.** 3d Ann. Rept. Maryland Agric. Ex. Sta., College Park, 1890, pp. 104–108. Gives table showing the susceptibility of a large number of varieties of strawberries to the leaf blight (*Sphaerella fragariæ*). Concludes varieties of Bidwell, Van Deman, Anna Forest, Haverland, Hoffman, daisy, ruby, and bubach No. 5 are the five least susceptible varieties situated on the station grounds. Gives résumé of results and recommendations of preventive treatment, quoting from Garman and others. (D. G. F.)

5. [CHURCHILL, GEORGE W.] **Some of the most common fungi and insects—with preventives.** Bull. N. Y. Agric. Ex. Sta., new ser., No. 35, Geneva, Aug., 1891. pp. 603–627. Gives reprints from reports of U. S. Dept. of Agriculture describing black rot, downy mildew, anthracnose, powdery mildew, grape leaf blight, white rot, bitter rot of grape, leaf-blight of the strawberry, orange rust, and anthracnose of the raspberry; formulæ for fungicides, methods of applying the remedies, and cost of the treatments. Apple scab, black knot of the plum and cherry, with original notes. (See also 9th Ann. Rept. N. Y. State Agric. Ex. Sta., for 1890, pp. 309–351; Exper. Sta. Rec., vol. 3, Jan. 1892, pp. 403–404.) (D. G. F.)

16. CLARK, JOHN W. **Pear or fire blight** (*Micrococcus amylovorus*, Bur.). Bull. Mo. Agric. Col. Ex. Sta., No. 16, Columbia, Nov., 1891, pp. 8–10, diagram. Gives results of experiments in orchard at the college. No remedy but cutting out. Dwarf and standard trees blight equally. (J. F. J.)

17. COOKE, M. C. **Another vine disease** (*Glœosporium pestiferum*, C. & M.). Gard. Chron., 3d ser., vol. 9, No. 212, London, Jan. 17, 1891, p. 82, ½ col. Describes the microscopic characters and injury to the host. The specimens came from Brisbane, Queensland, Australia. (M. B. W.)

18. DETMERS, FREDA. **Diseases of the raspberry and blackberry.** Bull. Ohio Agric. Ex. Sta., 2d ser., vol. 4, No. 6, Columbus, Oct., 1891, pp. 124–129, pl. 2. Describes the external appearance of the disease caused by the *Glœosporium venetum*, Speg., *Septoria rubi*, Westd., and *Cæoma nitens*, Schw. Refers to note in Hedwigia, 1891, Heft 3, p. 178, by C. A. J. A. Oudemans, who shows the name *Cæoma interstitiale* of Schlechtendal has priority over the old name of *C. nitens*, Schw. Describes the disease of raspberry canes, "which causes wide, dark discolorations of the bark without rupture of any kind," as of bacterial origin. Quotes letter of Burrill to this effect and mentions that cultures of the organism have already been made. (See Ex. Sta. Rec. Washton, vol. 3, Jan., 1892, p. 411.) (D. G. F.)

419. FAIRCHILD, D. G. **Notes on a new and destructive disease of currant canes.** Bot. Gazette, vol. 16, No. 9, Sept. 15, 1891, p. 262. Notice of paper read before Bot. Club of A. A. A. S., Aug., 1891, describing work on the disease, showing it to be caused by peculiar species of fungus as yet unclassified. (J. F. J.)

420. [GALLOWAY, B. T.] **[Black rot, downy mildew, and anthracnose of the grape.]** Circular No. 11, Div. Veg. Path., U. S. Dept. of Agric., 1891, p. 1. A circular containing ten questions, issued to ascertain the per cent of loss from diseases of grapes, and extent of the use of fungicides recommended by the Division. (J. F. J.)

421. FLORIDA DISPATCH, FARMER AND FRUIT GROWER. **The cracking of fruit and vegetables.** Fla. Disp., Farmer and Fruit Grower, new ser., vol. 3, Jacksonville, Mar. 19, 1891, pp. 224–225, 2 cols. Review of article by E. S. Goff discussing in popular language the causes of cracking of fruits and vegetables. Mentions *Fusicladium* as cause of cracking of pears. Gives results of experimental demonstration of osmotic action as cause of cracking of ripe apples. (D. G. F.)

422. HALSTED, B. D. **Fungi injurious to fruits.** Science, vol. 18, New York, Dec. 18, 1891, pp. 337–338. Extract from paper read before Ohio State Horticultural Society. Advocates keeping plants in good condition and thus enabling them to better resist attacks of fungi. Believes also in rotation of crops, especially root crops attacked by disease. (See also Prairie Farmer, vol. 64, Jan. 30, 1892, ½ col.) (J. F. J.)

423. HALSTED, B. D. **Experiments for the year upon cranberry diseases.** Rept. N. J. State Board Agric., vol. 18, Trenton, 1891, pp. 266–272. Quotes act passed by legislature of New Jersey to prevent spread of fungous diseases of plants. Refers to occurrence of cranberry-gall fungus (*Synchytrium vaccinii*) and to cranberry scald. Gives results of experiments with fungicides, but con-

cludes that the conditions favoring the scald are to be found in the bog, its soil, water, etc. "The cure for the malady must be in a renovated bog." (J. F. J.)

424. HALSTED, B. D. **Papers on fungi injurious to fruits and fungi injurious to garden crops.** Read before the Ohio State Horticultural Society at Zanesville, Ohio. Columbus, December, 1890 (1891), pp. 13. Gives popular account of the various parasitic fungi of fruits and vegetables. (D. G. F.)

425. [HUNN, C. E.] **Diseases of the raspberry.** Bull. N. Y. Agric. Ex. Sta., new ser., No. 36, Geneva, Sept., 1891, p. 641, one-half page. Describes disease and mentions treatment in progress at the station. (D. G. F.)

426. JONES, L. R. **Apple rust and cedar apples.** Fourth Ann. Rept. Vt. Agric. Ex. Sta., Burlington, 1890, p. 139. Reports serious case of rust of apple leaves caused by *Gymnosporangium* sp. *Rœstelia* stage, from cedar trees in vicinity of orchard. A simple experiment was undertaken to test the effect of spraying with ammoniacal copper carbonate [1 oz. carbonate in 1 quart ammonia, 22 gallons of water]. Sprayings made May 17 and May 30 after first appearance of jelly-like sori on cedar apples failed to prevent the appearance of the Rœstelia upon the apple leaves. (D. G. F.)

427. JONES, L. R.. **Notes upon some other fungous diseases which are prevalent.** Fourth Ann. Rept. Vt. Agric. Ex. Sta., Burlington, 1890, pp. 142–144. Gives notes upon black scab of apple, black scab of pear, pear blight, strawberry leaf blight, currant rust or leaf spot disease (*Septoria ribis*, Desm.), raspberry and blackberry cane rust, ergot, grape mildews, hollyhock rust, mostly of nature of popular description. (D. G. F.)

428. KELLER, ROB. **Die amerikanischen Reben und ihre Bedeutung für die europäische Rebenkultur.** Biologisches Centralbl., vol. 11, Nos. 3 and 4, Mar., 1891, Leipzig, pp. 65–74, 97–110. A review of recent literature on the subject, especially of Viala, "Une Mission viticole en Amérique." Mentions resistance of American vines against *Phylloxera*, *Peronospora*, and *Oidium*. Ascribes the weakness of European sorts to their not being adapted to resist the parasites. Sketches the history of *Læstadia Bidwellii*. (W. T. S.)

429. [? MASTERS, M. T.] **Gooseberry fungus.** Gard. Chron., 3rd ser., vol. 9, No. 232, London, June 20, 1891, p. 770, one-eighth col., fig. 3. Brief note of occurrence with figures of the fungus *Æcidium* and diseased fruit and leaves. (M. B. W.)

430. PAMMEL, L. H. **A destructive disease of the cherry.** Bot. Gazette, vol. 16, No. 9, Sept. 15, 1891, p. 266. Notice of paper read before Bot. Sec. Am. Asso. Agric. Col. and Ex. Sta., Aug., 1891, describing injurious effects of a species of *Cladosporium*. (See No. 331.) (D. G. F.)

431. PATOUILLARD ET DELACROIX. **Sur une maladie des dattes produite par le Sterigmatocystis phœnicis, (Corda) Patouill. et Delacr.** Bull. Soc. Mycol. France, vol. 7, Paris, June 30, 1891, pp. 118–120, pl. 1. Changes *Ustilago phœnicis*, Corda, to the genus *Sterigmatocystis*. Describes the external appearance of the diseased fruits, and gives diagnosis of the species. (E. A. S.)

432. [PECK, C. H.] **Fungi on plums.** Cult. and Country Gent., vol. 56, Albany, May 21, 1891, p. 416, 1 col. Discusses, in answer to inquiry, diseases caused by *Monilia fructigena*, Pers. and *Exoascus pruni*. States hyphæ of the former incapable of penetrating the unruptured epidermis of various fruits. Recommends for *Monilia*, applications of fungicides; for *Exoascus*, application of fertilizers to roots of trees. (D. G. F.)

433. SHEPPARD, J. **Grapes cracking and scalding.** Gard. Chron., 3d ser., vol. 10, No. 239, London, July 25, 1891, p. 101, 1 col. *Ibid*, Aug. 1, No. 240, p. 138, one-half col. Ascribes the injuries to grapes in greenhouses to changes in temperature and moisture and gives remedy. (M. B. W.)

4. SCRIBNER, F. LAMSON. **Some fungous diseases of the grape.** Bull. Agric. Ex. Sta., Univ. of Tenn., vol. 4, No. 4, Knoxville, Oct., 1891 [Dec., 1891], pp. 97–118, figs. 26. Describes black rot of grape, its cause, mycelium, organs of reproduction, parts of vine attacked, conditions favoring disease, treatments, and results. Brown rot with treatment; anthracnose and bird's-eye rot and grape leaf-blight. Refers briefly to general treatment of fungous diseases, the use of powders, liquids, and spraying pumps. (J. F. J.)

35. VIALA, PIERRE. **Monographie du pourridie des vignes et des arbres fruitiers.** Montpellier, 1891, pp. 120, pl. 7. A thesis presented to the Paris Faculty of Science. Deals principally with *Dematophora necatrix.* See review in this JOURNAL, page 149. (E. A. S.)

36. VIALA, PIERRE. **Une maladie des greffes boutures.** Rev. Gén. d. Bot., t. 3, No. 28, Paris, April 15, 1891, pp. 145–149, fig. 1. Gives short description of a disease of grape grafts caused by *Sclerotinia Fuckeliana,* which attacks the freshly cut surfaces of grafts when placed in the packing house previous to planting in the nursery. The fungus forms small wrinkled sclerotia upon the cambium of the cut surfaces, which sclerotia, when cultivated, produce both the *Botrytis* and the *Peziza* form; recommends that the sand used as packing for the grafts be spread out in the sun to dry when not in use in the summer time. (D. G. F.)

137. VIALA, P., and BOYER, G. **Une nouvelle maladie des raisins.** (*Aureobasidium vitis,* n. sp.) Rev. Gén. d. Bot., t. 3, No. 33, Sept. 15, 1891, pp. 369–371, pl. 1. Describes a new disease of the grape clusters appearing in Bourgogne and Thomery since 1882. The disease is present in wet seasons in the month of September or October upon berries almost mature. The vegetative mycelium fills the whole pulp and sends out through the surface numerous yellow branches which bear on the points of basidia situated at their extremity, oval or cylindrical spores. Creates a new genus for the fungus, *Aureobasidium.* (D. G. F.)

438. WAGNER, J. J. **Les principales maladies de la vigne.** Bull. Mens. Soc. Sci. Agric. et Arts, vol. 25, Strasbourg, Feb., 1891, pp. 52–63. Popular account of *Peronospora viticola* and grape anthracnose with treatments. All drawn from one of Prof. Millardet's papers. (E. F. S.)

439. WAITE, M. B. **Results from recent investigations in pear blight.** Bot. Gazette, vol. 16, No. 9, Sept. 15, 1891, p. 259. Notice of paper read before section F, of A. A. A. S., Aug., 1891, giving results of study of disease. Finds motile bacillus grows in nectar of pear blossoms and multiplies there as a saprophyte before entering the meristematic tissue. Announces the fact that blight in the nectar is carried from flower to flower by insects. (D. G. F.)

440. WOBST, K. **Beiträge zur Brombeerflora des Königreichs Sachsen.** Sitzungsb. und Abh. d. Naturwiss. Gesells. Isis, in Dresden, Jahrg. 1890, Juli bis December, Dresden, 1891, Abh. pp. 50–59. On page 58 a half page is devoted to diseases of *Rubus.* Spot diseases were observed on *R. dumetorum* and *hirtus* produced by *Depazea areolata,* Fuckel and *Ascochyta rubi,* Lasch. Rust caused by *Phragmidium violaceum,* Schultz was found commonly in fall. Pathological conditions induced by insects and other animals are then noticed. (W. T. S.)

441. WURTZ. **The wine industry of Russia.** Repts. from Consuls of U. S. No. 125, Washington, Feb., 1891, pp. 271–283. Refers to diseases of the vine in various provinces. In Bessarabia they are *Erysiphe tuckeri,* and *Peronospora viticola.* No treatment is given the vines (p. 272). In the region of the Crimea the vines are troubled by *Erysiphe, Sphaceloma,* and *Peronospora.* Sulphur is used in combating *Erysiphe* on the southern coast (p. 275). In the region of the Caucasus, *Erysiphe* is common (p. 279). In the government of Kootaris, *Erysiphe* appeared in 1854 and killed about one-fourth of the vineyards and affected the production of others. *Peronospora* and *Sphaceloma* have also

caused great loss (p. 280). In the government of Tiflis the common dis[illegible] are *Erysiphe*, *Peronospora*, and *Sphaceloma* (p. 281). (J. F. J.)

(See also Nos. 342, 348, 424, 453, 455, 456, 459, 461, 468, 469, 470, 476, [illegible] 509, 511, 549, 632, and 633.)

D.—DISEASES OF FOREST AND SHADE TREES.

442. ANDERSON, ROBERT. **The canker of the larch.** Jour. Roy. Agric. Soc., 3d se[illegible] vol. 2, part 3, London, Sept. 30, 1891, pp. 643–644. Discusses treatment [illegible]vised by Carruthers and thinks cutting out would be successful, but th[illegible] there is no substitute for the larch. (M. B. W.)

443. CARRUTHERS, J. B. **The canker of the larch.** Jour. Roy. Agric. Soc., 3d se[illegible] vol. 2, part 2, London, June 30, 1891, pp. 299–311, fig. 8. A descrip[illegible]tion of *Dasyscypha Willkommii* (*Peziza Willkommii*) and its injuries to the la[illegible] with wood cuts illustrating its microscopic characters and distortions of t[illegible] host. Discusses the nomenclature, history, and occurrence of the fun[illegible] in England. The author differs from Ward in that he thinks the germ t[illegible] from the spores is able to penetrate sound bark if young, so that a cra[illegible] or wound is not necessary for the infection. Bark three or four years old [illegible] impervious to the fungus. Suggests keeping the fungus in check by cutting out and burning. (M. B. W)

444. MASTERS, M. T. **Larch canker.** Gard. Chron., 3d ser., vol. 10, No. 241, London, 1891, p. 160, 1 col. Review of article in the Journal of the Royal Agricultural Soc. (See No. 443.) (M. B. W.)

445. MAYR, HEINRICH. **Die Waldungen von Nordamerika, ihre Holzarten, deren Anbaufähigkeit und forstlicher Werth für Europa im Allgemeinen und Deutschland insbesondere.** München (Riegerische), 1890, pp. 433–434. Enumerates the fungous parasites of forest trees of North America observed in autumns of 1885 and 1887. He includes the following new species. *Puccinidia abietis* n. gen. and n. sp. on *Abies concolor*, *Gymnosporangium Libocedri* on *Libocedrus decurrens*, *Chrysomyxa Libocedri* on *Libocedrus decurrens*, *Æcidium* sp.? on *Fraxinus* sp., *Æ. deformans* on *Pinus mitis*, *Exoascus quercus-lobatæ* on *Quercus lobata*, *Sclerotium irritans* on *Chamæcyparis sphæroidea*, *Rhytisma punctiforme* on *Acer macrophyllum*, *Lophodermium* (*Hysterium*) *baculiferum* on *Pinus ponderosa*, *P. resinosa*, and *P. laricio*, *L. abietis-concoloris* on *Abies concolor*, *L. infectans* on *Abies concolor*, *Dothidea betulina* on Birch sp., *Microsphæra* (*Erysiphe*) *corni* on *Cornus florida*, *Fusicladium* sp.? on *Abies Fraseri*, *Hysteriopsis acicola* n. gen. and n. sp. on *Picea Sitkænsis*. Includes various other fungi, thirty-four in all, and figures numerous species. Notes effects of *Trametes pini*. *Podosphæra corni* is figured as a *Microsphæra* and several species are very doubtfully determined. (D. G. F.)

E.—DISEASES OF ORNAMENTAL PLANTS.

446. HALSTED, B. D. **An orchid anthracnose.** Garden and Forest, vol. 4, No. 175, New York, July 1, 1891, p. 309. Notes a species of *Glæosporium* on orchids, causing damage in greenhouses. Thinks species distinct from *Glæosporium cinctum*, B. & C., having spores double the latter's size and being straight instead of curved. (D. G. F.)

447. HALSTED, B. D. **Hollyhock diseases.** Garden and Forest, vol. 4, No. 189, New York, Oct. 7, 1891, p. 477, ½ col. Enumerates five different fungous diseases of hollyhock: *Cercospora althæina*, *Puccina malvacearum*, *Colletrichum malvarum*, *Phyllosticta althæina*, and *Septoria Fairmani*. (D. G. F.)

448 HALSTED, B. D. **Pelargonium blight.** Garden and Forest, vol. 4, No. 187, New York, Sept. 23, 1891, p. 453. Notes, with popular description, a *Colletotrichum* and an *Aschochyta*. (D. G. F.)

449. HALSTED, B. D. **Rust of carnations.** Garden and Forest, vol. 4, No. 199, New York, Dec. 16, 1891, p. 596, ½ col. Notes occurrence of *Uromyces caryophyllinus* on carnations received from Philadelphia and gives brief description of its appearance. Concludes that a plant once rusted can not be cured. Thinks with healthy plants the disease may be prevented by spraying with copper salts. (J. F. J.)

450. KEAN, ALEXANDER LIVINGSTON. **The lily disease in Bermuda.** Technology Quarterly, vol. 3, No. 3, Boston, Aug., 1890, pp. 253–260. Same as No. 6. (D. G. F.)

451. MASSEE, GEORGE. **A primula disease,** Gard. Chron., 3d ser., vol. 10, No. 256, London, Nov. 21, 1891, p. 626, 2 cols., fig. 1. Gives an account of a disease caused by *Ramularia primulæ*, Thüm., with a figure and description of the fungus; finds spores unable to germinate in a 1 per cent solution of copper sulphate. (M. B. W.)

452. SMITH, W. G. **Disease of hollyhocks.** Gard. Chron., 3d ser., vol. 9, June 27, 1891, pp. 791–792, 1 col., figs. 2. The writer has obtained the mature fruit of a hollyhock disease caused by *Peziza sclerotiorum*. Gives figures of the fungus. (M. B. W.)

(See also No. 427.)

D.—REMEDIES, PREVENTIVES, APPLIANCES, ETC.

453. ALWOOD, WM. B. **Treatment of diseases of the apple.** Southern Planter, 52d year, No. 3, Richmond, March, 1891, pp. 130–131, 3 cols. Gives results of experiment in treatment of apple scab in Virginia, using one early treatment with lye (1 lb. concentrated lye to 10 gallons of water), followed by three later treatments with Bordeaux mixture containing 2, 4, and 6 pounds of copper sulphate; three later treatments with the Masson mixture (copper sulphate and sodium carbonate), 2, 4, and 6 pounds of copper sulphate being used at the three respective treatments; three later treatments with the ammoniacal solution (3 oz. copper carbonate and 1 quart of ammonia 22° Baumé); three later treatments with potassium sulphide (½ oz. sulphide per gallon of water). Although author was not present at harvest gives statement of owner of orchard where experiment was located which points to superiority of the ammoniacal solution as a prevention of the scab. Thinks treatment with lye had good effects. (D. G. F.)

454. AULD, J. MCQUEEN. **Oxide of iron for foot rot.** Fla. Disp., Farmer and Fruit Grower, new ser., vol. 3, Jacksonville, June 11, 1891, p. 463. Records sequence of healthy condition of trees previously attacked by foot rot following application of oxide of iron 5–15 pounds per tree. (D. G. F.)

455. BEUCKER, GEORGE. **Treatment of grape mildew at the school of agriculture at Montpellier, France.** Annals of Horticulture in N. Am. for 1890, New York, 1891, pp. 82–87. Translation by L. H. Bailey of article in *Progrès Agricole* relative to experiment with fungicides in treatment of grape diseases. The author reports a test of the following fungicides: Bordeaux mixture, verdet (dibasicacetate of copper), improved Bordeaux (ordinary Bordeaux with addition of small amount of ammonia), Bordeaux mixture and glue, Masson mixture, (mixture of carbonate of soda and sulphate of copper), gelatinous hydrocarbonate of copper, aluminium mixture, Skawinski's powder, Skawinski's sulphur, cuprosteatite, sulfosteatite, sulfocyanide of copper, sulphated *verdet*, hydrated sulphate of copper, sulphated sulphur, cupro-phosphate, and sulphur with cupro-phosphate. Although the mildew did not make its appearance in the vineyard treated the author discusses at some length the nature of the different fungicides, highly recommending the verdet (dibasicacetate of copper) as the most adhesive copper mixture, remaining upon the leaves until November, last spraying being made July 25. Decides the powders inferior to the liquids, but indicates cuprosteatite as the best powder remedy. (D. G. F.)

456. BOYSEN, T. H. **Diseases of the grape and their prevention.** Rept. N. J. State Board Agric., Trenton, 1891, pp. 349–357. Describes *Peronospora viticola* as affecting grapes in New Jersey; also black rot. Gives method of prevention, advocating spraying with Bordeaux mixture. (J. F. J.)

457. BRUNK, T. L. **Treatment of Cladosporium fulvum.** Bot. Gazette, vol. 16, No. 9, Sept. 15, 1891, p. 265. Notice of a paper read before the Am. Asso. Agric. Coll. and Exper. Sta., August, 1891, announcing the successful use of carbonate of copper [3 oz. per 50 gallons of water, 1 pound of ammonia]. (D. G. F.

458. CHESTER, F. D. **Fungicides.** Bull. Delaware College Agric. Ex. Sta., Special A. Newark, March, 1890, pp. 4. Gives formula for fungicides. Simple sol sulphate of copper, Bordeaux mixture, modified eau celeste; and directions for treatment of black rot of grapes, pear scab, pear and apple leaf blight, strawberry leaf blight, raspberry and blackberry anthracnose, brown rot of peach and plum, gooseberry mildew, Irish potato blight. (D. G. F.)

459. CHESTER, F. D. **The leaf blight of the pear and the quince.** Bull. Delaware College Agric. Ex. Sta., Newark, No. 13, July, 1891, pp. 16, pl. 2. Describes disease caused by *Entomosporium maculatum* and gives results of comparative tests of modified eau celeste, Bordeaux mixture, precipitated carbonate of copper, ammoniacal carbonate of copper, carbonate of copper and carbonate of ammonia as preventives of pear leaf-blight. Reports modified eau celeste as giving best results, 85.1 per cent of sound fruit being picked from trees sprayed with it, as opposed to 84.4 for Bordeaux, 80.8 for precipitated carbonate of copper, 78.3 for ammoniated carbonate of copper, 66.3 for carbonate of copper and carbonate of ammonia mixture, and 42.0 for untreated. Records injury to foliage and russet appearance to fruit caused by use of the ammoniated carbonate of copper mixture, and also failure of combined treatment of ammoniated carbonate of copper, and carbonate of copper and carbonate of ammonia mixture to effectually prevent the quince leaf-blight caused by the same fungus. Mentions successful treatment of 1,000 pear trees at Milford, using Bordeaux mixture as preventive of the leaf-blight. (D. G. F.)

460. COUSINS, W. W. **Potato blight prevention.** Gard. Chron., 3d ser., vol. 10, No. 254, London, November, 1891, pp. 558–559, 2¼ cols. Records a number of successful treatments with Bordeaux mixture for potato blight (*Peronospora infestans?*). (M. B. W.)

461. CRAIG, JOHN. **Treatment of apple scab, grape and gooseberry mildew.** Bull. Central Ex. Farm, Dept. Agric., Canada, No. 10, Ottawa, April, 1891, pp. 15. After giving an account of losses from the disease, quotes from Galloway and Scribner as to the fungus, *Fusicladium denditricum*, and also from former's report of experiments in prevention of disease; gives results of experiments in Canada with fungicides as preventive. Concludes from comparative tests of copper carbonate in suspension in water, ammoniacal solution, copper sulphate and ammonia, copper sulphate dissolved in water, and hyposulphite of soda, that the copper carbonate in suspension gave the best results, even exceeding in efficacy the ammoniacal solution; that the copper sulphate, and ammonia and copper sulphate dissolved in water injured the foliage, while the hyposulphite of soda showed no effects because experiment was ruined, by leaf crumpler. Gives formulæ for preparation of fungicides and directions for treatment and also method for home preparation of copper carbonate. Discusses treatment of grape mildew (*Peronospora viticola*) and gooseberry mildew. (*Sphærotheca mors-uvæ*, B & C.) (D. G. F.)

462. DEGRULLY, L. **Les approvisionnements pour les traitements contre le mildiou.** Progrès Agricole, 8e ann., Montpellier, Nov. 29, 1891, p. 509, one-eighth page. Refers to treatment of plants with copper preparations, and advises that for 1892 provision be made to treat mildew with sulphate of copper. (J. F. J.)

63. Diller, Isaac R. [Report on the Agriculture, etc., of] Florence, [Italy]. Rep'ts from the consuls of U. S., No. 128, Washington, May, 1891, pp. 34–41. Refers (p. 34) to instructions given by Prof. Ferrari, of the Royal Technical Institute, to the soldiers of the farming class on the following subjects: (1) *Peronospora*, its character, development, damages, and remedies. (2) Treatment and method of applying sulphate of copper. (3) Phylloxera, its character and how to prevent its spread. Over 200 soldiers have attended the lectures, and great interest was manifested. (J. F. J.)

64. Dod, C. Wolley. **Portuguese remedy for vine mildew.** Gard. Chron., 3d ser., vol. 9, No. 210, London, Jan. 3, 1891, p. 23, one-third col. Mentions a patented fungicide containing sulphur, sulphate of copper, and lime in the form of powder, for use against the *Peronospora* of the vine. (M. B. W.)

65. Fairchild, D. G. **Plant diseases.** Ann. of Hort. in N. Am. for 1890, New York, 1891, pp. 76–82. Gives popular account of advances made during the year in the study and prevention of plant diseases. (J. F. J.)

66. Galloway, B. T. **A government spraying device.** Pacific Rural Press, vol. 40, No. 24, San Francisco, Dec. 13, 1890, p. 499, figs. 8. Reprint with figures of article in Journal of Mycology, vol. 6, p. 51. (D. G. F.)

67. Galloway, B. T. **Does it pay to spray?** Pop. Gardening, vol. 6, No. 31, Buffalo, Oct., 1891, p. 266, 1 col. Gives extract of paper read before the Society for the Promotion of Agricultural Science, Aug., 1891, Washington, D. C. Records results of experiments in Virginia in 1891, with following fungicides as preventives of black rot of the grape: Ammoniacal copper carbonate solution, modified eau celeste, precipitated carbonate of copper solution, copper saccharate, copper carbonate and glue mixture, Bordeaux mixture, copper acetate, and copper chloride mixture. Each of the above fungicides contained approximately the same amount of copper as the ammoniacal solution, 0.1 oz. per gallon of water. Reports results of the copper mixture as increasing the yield of perfect fruit from 20 to 50 per cent, while use of several non-cupric mixtures (potassium sulphide, sodium hyposulphite) gave increase of 20 to 38 per cent. Adds result on experiment with full and half strength of Bordeaux mixture, concluding the two mixtures to stand in relation of 96:86 in effectiveness. Reports experiment with pear leaf-blight and scab with same fungicides, in which the copper mixtures apparently slightly injured fruit and foliage. (D. G. F.)

468. Galloway, B. T. **Fungous diseases of the grape and their treatment.** Farmers' Bull., No. 4, U. S. Dept. of Agric., Feb., 1891, pp. 12. Gives a brief description of grape Peronospora, powdery mildew, black rot, and anthracnose. Describes remedies and gives formulæ for making fungicides. Gives methods for treatments and mode of applying fungicides, together with estimated cost of treatments and value of the same. (J. F. J.)

469. Galloway, B. T. **Plant diseases and their treatment.** Southern Planter, 52d year, Richmond, Nos. 10, 11, Oct., Nov., 1891, pp. 548–550, 615–616. Gives paper read before Farmers' Institute at Charlottesville, Va. A popular address. Sketches the rise of study of plant pathology in America, especially work of the Department of Agriculture. Gives formulæ for various fungicides and most approved methods of treatment of black rot, downy mildew, and anthracnose of the grape, potato rot, apple scab, and leaf blight of the pear. Answers numerous queries of audience. (D. G. F.)

470. Galloway, B. T. **Plant diseases and their treatment.** Ann. Rept. N. J. State Board Agric., vol. 18, Trenton, 1891, pp. 73–89, pl. 2, fig. 4. Mentions results of treatment of grapes for black rot and pear seedlings for leaf-blight. Refers to fungicides and spraying apparatus used, giving formulæ and description of apparatus, with instructions as to best methods. Quotes "Yellows" law of Michigan passed in 1881, and briefly describes the disease. (J. F. J.)

471. GALLOWAY, B. T. **Recent progress in the treatment of the diseases of pomaceous fruits.** Garden and Forest, vol. 4, No. 189, New York, Oct. 7, 1891, pp. 478–479. An address before the American Pomological Society, Sept., 1891. Gives résumé of work done for prevention of pear leaf-blight and apple scab. Gives description of two-horse machines for spraying nursery stock, and directions for treatment of nursery stock and apple trees for apple scab. (D. G. F.). See also Scient. Am. Supple., vol. 32, N. Y., Oct. 31, 1891, p. 13205.

472. GALLOWAY, B. T. **Treatment of nursery stock for leaf blight and powdery mildew.** Circular No. 10, Div. of Veg. Path., U. S. Dept. of Agric., 1891, pp. 8, figs. 3. Gives formulæ for preparation of fungicides used in treatment; Bordeaux mixture and ammoniacal solution, with instructions for their use and most approved appliances for their application. (D. G. F.)

473. GOETHE, R. **Wirkung des Kupferkalkes gegen pflanzliche und thierische Schädlinge.** Bericht K. Lehranst. für Obst. und Weinbau, für d jahr 1889–'90. Wiesbaden, 1891, pp. 29–30. Refers to a previous paper in the report for 1887–'88. Experiments show that a solution of 2 kg. of copper sulphate and 3 kg. fresh burnt and 4 kg. fresh slacked lime to 100 l. water successfully combat *Fusicladium pyrinum* and *F. dendriticum*, *Erysiphe pannosa* and *Sphærella sentina*, and these can be long held if the trees are sprayed with a solution of half the above strength before flowering and full strength afterwards. *Porthesia chrysorrhœa*, L., and the *Bombyx neustria*, L., become stiff and immovable after eating sprayed leaves. They then pupate. Other insects are enumerated that can be successfully combated with the mixture. (W. T. S.)

474. GREEN, W. J. **Treatment of raspberry anthracnose.** Bull. Ohio Agric. Ex. Sta., 2nd ser., vol. 4, No. 6, Columbus, Oct., 1891, pp. 119–121. Gives preliminary report on treatment of raspberry anthracnose with weak Bordeaux mixture (copper sulphate 4 lbs., lime 4 lbs., water 50 gallons); thinks results are encouraging, though not to be considered conclusive before a second season. (D. G. F.)

475. HALSTED, B. D. **Are fungicides abused?** Garden and Forest, vol. 4 No. 178, New York, July 29, 1891, p. 359, ½ col. Points out the imaginary character of any danger from proper use of fungicides. Replies to Dr. Hoskins's objection by statement that fungicides do not contain arsenic. (D. G. F.)

476. HALSTEAD, B. D. **The cranbery scald.** Garden and Forest, vol. 4, No. 193. Nov. 4, 1891, p. 524. Remarks on the unusual abundance of the scald in New Jersey bogs, and ineffectual use of ordinary fungicides in its prevention. Recommends covering the bogs with thick layer of sand. (D. G. F.)

477. HICKMAN, J. F. **Treatment of seed to destroy smut germs.** Bull. Ohio Agric. Ex. Sta., 2nd ser., vol. 4, No. 4, Columbus, Aug. 25, 1891, pp. 84–88. Gives results of treatment of wheat for stinking smut or bunt, using various strength of copper sulphate and hot water at varying temperature, after Jensen. Finds the best result obtained from use of hot-water treatment at temperature of 132° to 136° F. and 140° to 144° F. In 5,000 heads from untreated portion, 38 smutted heads were found, while in 5,000 from portions treated with hot water as above none were found. Finds no injury to grains from treatment with copper sulphate 4 oz. per 12 gallons of water. (D. G. F.)

478. HIGH, GEO. M. **Spraying grapes with eau celeste.** Cult. and Country Gent., vol. 56, Albany, Jan. 29, 1891, pp. 88–89, ½ col. Notes successful use of eau celeste in prevention of grape diseases at Middle Bass Island, Lake Erie. Places ratio of yield of sprayed to unsprayed as 2½ to 3 tons to 1 ton or less. Reports 200 acres as being sprayed with solution and gives account of analysis made of grapes sprayed, showing only trace of copper on clusters sprayed 4 times. (D. F. G.)

479. [HUNN, C. E.] **Gooseberry mildew—how prevented.** Bull. N. Y. Agric. Ex. Sta., new ser., No. 36, Geneva, Sept., 1891, pp. 645–646. Gives results of success-

ful treatments of powdery mildew with potassium sulphide, ¼ oz. to a gallon of water. (D. G. F.)

. JONES, L. R. **Black knot of plum and cherry.** Fourth Ann. Rept. Vt. State Agric. Exper. Sta., Burlington, 1890, p. 141. Recommends cutting out and burning all knots as remedy; also advocates State legislation against disease. (D. G. F.)

. JONES, L. R. **Potato blight and rot.** Bull. Vermont State Ex. Sta., No. 24, Burlington, May, 1891, pp. 19–32, 1 diagram. Records results of an experiment in the treatment of *Phytophthora infestans* by use of Bordeaux mixture. Shows that a single application of the mixture, Aug. 18, after first appearance of the disease, reduced the amount of rotten tubers to 15.3 per cent; two treatments, Aug. 18 and Sept. 16 reduced the amount to 9.7 per cent, as opposed to 53 per cent in the untreated portion of the field. Gives cost of the mixture and description for application. Records negative experiment of attempt to disinfect tubers already affected. Concludes that tubers soaked in copper sulphate were more or less injured, as were also tubers soaked in warm water or in a moist oven, while plants from tubers heated to 106°–108° F. in dry oven for 6 to 24 hours were on an average larger than plants from untreated tubers. Gives data showing that the dry rot appears more commonly at stem than at seed end of tuber. (D. G. F.) (See also 4th Rept. Vt. Agric. Ex. Sta., Burlington, 1890, pp. 131–136.)

82. KELLERMAN, W. A. **Corn smut.** Bull. Kansas State Agric. Ex. Sta., Bot. Dept., No. 23, Manhattan, Aug., 1891, pp. 101–104. Gives results of hothouse and field experiment to determine the possibility of artificially infecting young corn plants with smut from sorghum (*Ustilago Reiliana*) and also with corn smut (*Ustilago zea-mays*), which proved entirely negative. Spraying experiments using Bordeaux mixture, iron chloride, and potassium sulphide, did not prove effective in the prevention of the smut. (D. G. F.)

83. KELLERMAN, W. A. **Second report on fungicides for stinking smut of wheat.** Bull. Kansas State Coll. Agric. Ex. Sta., Bot. Dept., No. 21, Aug., 1891, pp. 47–72, pl. 1. Records second series of experiments in prevention of the stinking smut by the use of fungicides in treatment of seed wheat. Calls attention to discrepancy between Jensen's experiments and Kansas experiments, explaining it partially by discovery of inaccuray in thermometer used by the author, and thinks further the difference in estimation of smut may aid in the explanation. Discusses the extra increase in yield caused by the treatments and gives results from treatment of seed for 93 plats with 94 controls. Finds 18 of the treatments destroyed all the smut and gave a yield of grain greater than the average of the two adjacent untreated plats, 29 of the treatments decreased amount of smut to less than 1 per cent and gave yield larger than average of the two untreated plats, while 27 of the treatments injured the seed and 2 entirely killed it. Concludes with directions for use of the Jensen hot-water method, which consists in immersing seed wheat in water at 131° F. for 15 minutes. (D. G. F.)

484. KELLERMAN, W. A. **Smut of oats in 1891.** Bull. Kansas State Agric. Coll. Ex. Sta., Bot. Dept. No. 22, August, 1891, pp. 73–81. Estimates the amount of smut in vicinity of Manhattan, Kans., as varying from 3.2 to 7.92 per cent, in 1891. Gives results of series of experiments to test efficacy of immersing seed in various strengths of solution of potassium sulphide for various periods of time as preventive of the smut. Also test of use of flowers of sulphur. Shows great efficacy of potassium sulphide, recommending formula of 1 pound sulphide in 20 gallons of water, seed to be immersed 24 hours; or 2 pounds sulphide in 20 gallons water, seed to be immersed only 8 to 12 hours. To determine more accurately the extra increase, *i. e.* the increase above that equal to the amount destroyed by the smut, five differ-

ent treatments of hot water and one of potassium sulphide repeated in six different plats were made. The results show an average extra increase of treated over untreated of at least double the amount of that destroyed by smut in the untreated plats. (D. G. F.)

485. KELLERMAN, W. A. **Smuts of sorghum.** Bull Kansas State Agric. Coll. Ex. Sta. Bot. Dept., No. 23, Aug., 1891, pp. 95–101, pl. 3. Distinguishes two species of sorghum smut in Kansas: Grain smut (*Ustilago sorghi* (Link?) Passerini) and head smut (*Ustilago Reiliana*, Kuhn), giving distribution in United States as far as known. Records series of experiments in greenhouse, proving possibility of infection of sorghum plants by infection of seed with spores, and series of field experiments with fungicides, which gave contradictory results. (D. G. F.)

486. KELLERMAN, W. A. **Spraying to prevent wheat rust.** Bull. Kansas State Agric. Ex. Sta., Bot. Dept., No. 22, Aug., 1891, pp. 90–93. Gives result of experiments with several varieties of wheat, barley, and oats to ascertain the value of sulphur, potassium sulphide, iron chloride, and the Bordeaux mixture as fungicides in prevention of the rust. Finds, although the attack of the rust was a violent one, none of the treatments prevented the disease perceptibly, Bordeaux mixture possibly excepted, as giving slightly beneficial results. (D. G. F.)

487. KELLERMAN, W. A. **Test of fungicides to prevent loose smut of wheat.** Bull. Kansas State Agric. Coll. Ex. Sta., Bot. Dept., No. 22, Aug., 1891, pp. 81–90. Reports amount of loose smut of wheat on college farm in 1891 as ranging from 0 per cent to 16 per cent. Gives entirely negative results of use of following chemicals as fungicides in its prevention: Bordeaux mixture, eau céleste, potassium bichromate, copper nitrate, copper sulphate, copper chloride, mercuric chloride, Ward's seed manure, and hot water; 109 plats in experiment. (D. G. F.)

488. KILGORE, B. W. **Combination of arsenites with fungicides.** Bull. North Carolina Agric. Ex. Sta., No. 77 *b*, Technical No. 2, Raleigh, July 1, 1891, pp. 8–11. Gives analyses showing amount of soluble arsenic (As_2O_3) in arsenical mixtures having in solution copperas, copper sulphate, and iron chloride. Finds the injury to the leaves is in direct proportion to the amount of soluble arsenic present in the mixtures and that this amount is increased by the mixing of the above substances with white arsenic, Paris green, or London purple. Shows entire absence of soluble arsenic in mixtures of Paris green or London purple with Bordeaux mixture and records no ill effects to leaves of fig, grape, mulberry, blackberry, peach, pear, and apple from the application of these mixtures. Proportion, 1 pound of arsenite to 100 gallons of mixture. Shows great power of ammonia and sodium carbonate as solvents of arsenites and warns against use of eau céleste with arsenites. (D. G. F.)

489. KINNEY, L. F. **The downy mildew of the potato blight. The Bordeaux mixture as a preventive of the potato blight, experiments with, at this station.** 3d Ann. Rept. R. I. Agric. Ex. Sta., Part II, Providence, Jan., 1891, pp. 137–152 pl. 4. After giving description of disease, copying Scribner, records results of field experiment in its treatment. The experiment was made in field of 30 different varieties of potatoes, and careful estimates of number and weight of tubers from vines sprayed and not sprayed with Bordeaux mixture, formula *b*, show that late potatoes were much more benefited by spraying than were early varieties. Concludes yield of merchantable tubers was increased 9.9 per cent by spraying three times with Bordeaux mixture, due to increase in size of tubers; that percentage of rotted tubers was 150 per cent greater in untreated than treated vines; that the yield of merchantable potatoes was increased 34.5 per cent by five sprayings and the rot decreased, when correction for varieties is made, by 253.3 per cent in number of affected tubers. (D. G. F.)

90. [? MASTERS, M. T.] **American blight and canker.** Gard. Chron., 3d. ser., vol. 9, London, p. 114, ⅛ col. Gives a formula for a remedy for this disease made up of lime, sulphur, soap, paraffin, boiled oil, and nux vomica. (M. B. W.)

91. [? MASTERS, M. T.] **Apple scab.** Gard. Chron., 3d ser., vol. 9, May 30, 1891, p. 677, ½ col. Note on treatment taken from Bulletin No. 10, Central Expt. Farm, Dept. of Agriculture, Ottawa, Canada. (M. B. W.)

92. [? MASTERS, M. T.] **Bouillie bordelaise and French wines.** Gard. Chron., 3d ser., vol. 9, May 16, 1891, p. 621, ¼ col. Refers to report of British consul at Bordeaux, relating to analyses recently made by the Agricricultural Society of Gironde of wines made from grapes treated with Bordeaux mixture, showing them to be quite innocuous. (D. G. F.)

93. [? MASTERS, M. T.] **Carbonate of copper.** Gard. Chron., 3d ser., vol. 9, May 30, 1891, p. 677, 6 lines. Directions for making with copper sulphate and sodium carbonate. (M. B. W.)

94. [? MASTERS, M. T.] **Copper compounds for plant disease.** Gard. Chron., 3d ser., vol. 10, Aug. 15, 1891, p. 196, ¼ col. Notices their growing importance in horticulture, and the use of Bordeaux mixture to prevent *Peronospora Schachtii* on the sugar beet. (M. B. W.)

95. [? MASTERS, M. T.] **Copper sulphate as a fungicide.** Gard. Chron., 3d ser., vol. 9, May 30, 1891 p. 678, ¼ col. Quotes from Burrill, of the Ill. Agric. Expt. Sta., that the copper compounds are efficient remedies for many plant diseases. (M. B. W.)

96. [? MASTERS, M. T.] **Gooseberry mildew, how prevented.** Gard. Chron., 3d ser., vol. 9, June 6, 1891, p. 708, ½ col. Notes the successful treatment of this disease at the New York Agric. Expt. Sta., Geneva, with potassium sulphide. (M. B. W.)

97. [? MASTERS, M. T.] **Lime as a preservative for potatoes and fruit.** Gard. Chron., 3d ser., vol. 10, Oct. 17, 1891, p. 460, ½ col. States that M. Montclair successfully preserved fruits and potatoes from decay by the use of lime. (M. B. W.)

98. [? MASTERS, M. T.] **Mildew.** Gard. Chron., 3d ser., vol. 9, June 6, 1891, p. 708, ½ col. Review of circular by B. T. Galloway; states that 10,000,000 young fruit trees will be treated this year. (M. B. W.)

99. [? MASTERS, M. T.] **Peach blister.** Gard. Chron., 3d ser., vol. 10, Oct. 24, 1891, p. 491, 4 lines. M. de la Bastie, president of the Pomological Society of France, is said to have prevented this by the use of sulphate of copper. (M. B. W.)

500. [? MASTERS, M. T.] **Potato disease and the Bordeaux mixture.** Gard. Chron., 3d ser., vol. 10, Nov. 21, 1891, p. 617, ¼ col. Note stating that the treatment by this means was reported successful to the U. S. Dept. of Agriculture. (M. B. W.)

501. [? MASTERS, M. T.] **Potato experiments.** Gard. Chron., 3d ser., vol. 10, Aug. 1, 1891, p. 137, ¼ col. Notes the fact that the Royal Agric. Soc. is carrying on experiments with sulphate of copper to prevent disease of potatoes. (M. B. W.)

502. [? MASTERS, M. T.] **Sulphate of copper and potato disease.** Gard. Chron., 3d ser., vol. 9, May 2, 1891, p. 561, ½ col. Says that there is no question of its efficiency and notes successful experiments at the Conn. Agric. Expt. Sta. (M. B. W.)

503. [? MASTERS, M. T.] **The destruction of blight on plum trees.** Gard. Chron., 3d ser., vol. 10, Nov. 21, 1891, p. 618, ⅛ col. Gives formula for a mixture to spray on plum trees "to destroy blight and insect pests generally." (M. B. W.)

504. [? MASTERS, M. T.] **The potato disease.** Gard. Chron., 3d ser., vol. 10, July 4, 1891, p. 14, 1¼ cols. A warning to potato-growers to be ready to combat the disease on its first appearance. Recommends Bordeaux mixture and other fungicides. (M. B. W.)

505. [? MASTERS, M. T.] **The potato disease.** Gard. Chron., 3d ser., vol. 10, July 11, 1891, p. 47, ¼ col. Recommends for treatment Tait's anti-blight, a dry powder. (M. B. W.)

506. [? Masters, M. T.] **The potato disease.** Gard. Chron., 3d ser., vol. 10, Oct. 3, 1891, p. 490, ½ col. States that tubers of potatoes whose foliage had been treated with copper were submitted to chemical analysis, and less than one-hundredth grain of copper per pound was found, the same as in the untreated. (M. B. W.)

507. McCarthy, Gerald. **Plant diseases and how to combat them.** Bull. North Carolina Agric. Ex. Sta., No. 76, Raleigh, Mar., 1891, pp. 20. Gives popular review of what fungi are, general means of prevention, sanitary, etc. Gives formulæ of fungicides, pointing to error in translating value of hectoliter of the French into 22 gall. English measure, instead of 26¼ gall. U. S. standard. Following mixtures described: Simple solution of copper sulphate, simple solution iron sulphate, Bordeaux mixture, modified eau céleste, Burgundy mixture modified (cop. sulphate, 2¼ lbs.; sodium carbonate, 3½ lbs.; hard soap, one-half lb., water, 22 gallons), ammoniacal solution, Nessler's powder (cop. sulphate, 1 lb.; air-slaked lime, 2 lbs.; road dust or gypsum, 10 lbs.; water, 1 gallon). Discusses spraying machinery, protection afforded by wooden covering to trellises, and the diseases of black rot (*Læstadia Bidwellii*), mildew (*Peronospora viticola*), anthracnose (*Sphaceloma ampelinum*), black knot (*Plowrightia morbosa*), peach rot (*Monilia fructigena*), apple scab (*Fusicladium dendriticum*), pear-leaf blight (*Entomosporium maculatum*), pear fire-blight, peach yellows, potato blight (*Phytophthora infestans*), rust of cereals (*Puccinia graminis*), smut of small grains (*Tilletia fœtens* and *Ustilago segetum*), corn smut (*Ustilago maydis*) ergot (*Claviceps purpurea*). (D. G. F.)

508. McCarthy, Gerald. **Spraying, its value and danger.** Cult. and Country Gent., vol. 56, No. 2000, Albany, June 11, 1891, p. 477, 2 cols. Southern Planter, 52d year, Richmond, Aug., 1891, p. 430. Notice of paper on "copper salts, a possible source of danger" published in Agric. Science, vol. 5, June, 1891, pp. 156–158. See No. 295. (D. G. F.)

509. Pammel, L. H. **Treatment of fungus diseases.** Bull. Iowa Agric. Ex. Sta., No. 13 [Ames], Des Moines, May, 1891, pp. 31–51, figs. 22. Summarizes work upon treatment of black rot of grapes and pear leaf-blight; gives formulæ and cost of fungicides; apparatus for their application. Reports the failure of two sprayings of Bordeaux mixture and one of ammoniacal solution to prevent the apple rust (*Rœstelia*) and also the negative results from an experiment in the treatment of plum rust. *Septoria ribis* and *Cercospora angulata* more or less successfully treated with one spraying of Bordeaux and two of ammoniacal solution. Gives results of an experiment in the use of Bordeaux mixture and ammoniacal solution in the treatment of *Cylindrosporium padi*. Karsten (spot disease of cherry.) Brief instructions as to the treatment of apple scab, strawberry leaf-blight, spot disease of the cherry and plum, pear leaf-blight, spot disease of currants, and potato rot. (D. G. F.)

510. Pearson, A. W. **Copper salts and vegetation.** Garden and Forest, vol. 4, No. 191, New York, Oct. 21, 1891, pp. 498–500, 1½ cols. Shows danger of excessive use of copper salts as fungicides, giving results of treatment of Peachblow potatoes continuously with Bordeaux mixture. Finds in treatment of corn with copper sulphate, of potato seed with Bordeaux mixture, and sweet potatoes in the hotbed that their germination was seriously retarded. Sweet potatoes planted in hotbeds following seed previously treated with Bordeaux mixture failed to sprout. Thinks the surface-feeding plants, weeds, etc., in treated vineyards have been affected by the use of the copper fungicides. (D. G. F.)

511. Periam, Jonathan. **Strawberry leaf-blight fungus.** Prairie Farmer, vol. 63, No. 36, Chicago, September 5, 1891, p. 566, one-half col., fig. 1. Gives popular extract from Bull. Ky. Agric. Ex. Sta. See No. 197. (D. G. F.)

512. Petermann, M. **Treatment of potato disease.** Agriculture Science, vol. 5, No. 7, July, 1891, pp. 182–183. Reviewed from Jour. d'Agric. prat., vol. 55, Bruxelles, Jan., 1891, pp. 499–501. Shows effectiveness of Bordeaux mixture (50 kilos

of cryst. copper sulphate, 25 kilos of lime, and 25 hectoliters of water) and mixture of iron sulphate and lime (50 kilos iron sulphate, 25 kilos of lime, 25 hectoliters of water) in treating *Phytophthora infestans*. The Bordeaux mixture gave the most satisfactory results, and the author feels warranted in recommending provisionally the use of the mixture immediately upon appearance of the disease. An analysis of soil and plant sprayed June 21, made Aug. 4, gave no signs of copper. (D. G. F.)

513. PLOWRIGHT, C. B. **Bordeaux mixture and the potato disease.** Gard. Chron., 3d ser., vol. 10, No. 256, London, Nov. 21, 1891, pp. 609–610, 1¼ cols. Describes the experiment of Mr. R. Brown, of Donagmore, Tyrone, in which he disease was successfully treated. (M. B. W.)

514. PLOWRIGHT, C. B. **Messrs. Sutton & Sons' experiments with Bordeaux mixture.** Gard. Chron., 3d ser., No. 253, vol. 10, Oct. 23, 1891, p. 523, two-thirds col. States that these experiments in treatment of potato blight were unsuccessful and were opposed to the reports from all countries, and asks the question "why?" (M. B. W.)

515. PLOWRIGHT, C. B. **The Bordeaux mixture; some experiments on the preparation and effects on vegetation of the Bordeaux mixture.** Gard. Chron., 3d ser., vol. 10, No. 255, Nov. 14, 1891, p. 593, 1½ cols. Shows the necessity of having a good quality of fresh lime to decompose all the copper sulphate. (M. B. W.)

516. POWELL, GEO. T. **The scare about sprayed grapes.** Cult. and Country Gent., vol. 56, No. 2020, Albany, Oct. 15, 1891, p. 836, 1 col. Refers to hasty action of New York City board of health in condemning grapes sprayed with the Bordeaux mixture. Thinks condemnation was not warranted. (D. G. F.)

517. SCOVELL, M. A. AND PETER, A. M. **Smut.** First Ann. Rept. Ky. Agric. Ex. Sta., Frankfort, 1890, p. 126. Reports prevention of smut by treating wheat with copper sulphate, 10 pounds of sulphate to 8 gallons of water. Seed wheat was immersed in solution and spread on boards to dry. Treatment reported entirely successful. (D. G. F.)

518. SCRIBNER, F. L. **Does it pay to combat plant diseases by spraying?** Orchard and Garden, vol. 13, Little Silver, N. J., Nov., 1891, p. 185, ½ col. Cites two instances of successful use of Bordeaux mixture, one in which 203 vines were sprayed 8 times to prevent rot, at a total cost of $6.51, saving $32.40 worth of grapes; and a second in which 8,450 vines were treated 7 times and the estimated profit shown by control vines were $1,800. (D. G. F.)

519. [SORAUER, PAUL.] **Sulphostéatite cuprique (Kupfervitriol-Speckstein).** Zeitschr. für Pflanzenkrankheiten, Bd. 1, heft. 1, Stuttgart, 1891, p. 49–50. Notice of a circular of Jean Souheur in Antwerp on the cupric sulphosteatite which he introduced in 1890, said to stick very well. Gives account of methods of applying to grapes, tomatoes, and potatoes. (W. T. S.)

520. STAHL, J. M. **Bordeaux mixture for pear leaf-blight.** Cult. and Country Gent. 61st year, Albany, Dec. 31, 1891, p. 1054, 1½ cols. Advocates use of Bordeaux mixture as cure for pear leaf-blight. Quotes from various letters giving good results in its use. Gives method adopted. (J. F. J.)

521. SUMMEY, ELMER E. **Shall we protect our apple crop?** Cult. and Country Gent., 61st year, No. 1998, Albany, May 14, 1891, pp. 396–397, 2 cols., figs. 2. Describes methods of spraying orchards recommended by the Department of Agriculture and others to prevent the apple scab; figures pump and bamboo lance. (D. G. F.)

522. VAN SLYKE, L. L. **Fungicide analysis and valuation.** Cult. and Country Gent., 61st year, No. 2006, Albany, July 9, 1891, p. 556, 2 cols. Gives analyses of commercial copper sulphate, copper carbonate, and Powell's "Copperdine." Shows samples of copper sulphate from the Nichols Chemical Company, New York, contained 99.6 per cent of copper sulphate and samples from various other sources contained from 98.6 to 98.1 per cent of sulphate. Finds in one sample sent from West Park, New York a considerable quantity of free

sulphuric acid. Finds samples of copper carbonate to contain from 87 per cent to 88.1 per cent. Shows Powell's "Copperdine," both dry and liquid, does not contain the amount of copper which it purports to. Gives simple tests for purity of copper as complete solution in water, nitric acid, and ammonia. (D. G. F.)

523. VEITCH, ROBERT, & SON. **Potato disease.** Gard. Chron., 3d ser., vol. 10, London, Sept. 17, 1891, p. 344, ½ col. Reports successful treatment by copper compounds. (M. B. W.)

524. WASHBURN, F. L. **Practical work with the codling moth and with a combined insecticide and fungicide.** Bull. No. 10, Oregon Agric. Ex. Sta., Portland, Apr., 1891, pp. 11–13. Gives formulæ for combined treatment of fungi and insects. (*a*) 10 pounds whale oil soap dissolved in 20 gallons of water; (*b*) 1 pound concentrated lye, 2 pounds sulphur, and 1 gallon of water, heated until thoroughly mixed and dark brown. Add *b* to *a* and then heat for half an hour; add 30 gallons of water, and use at a temperature of 120° F. Gives variable results obtained in experiments with above formula. No control trees left untreated to show actual difference, but author thinks the absence of scab on trees treated 5 times shows efficacy of solution as a fungicide. (D. G. F.)

525. WHITE, J. M. **[Remarks on spraying.]** Rept. N. J. State Board Agric., vol. 18, Trenton, 1891, pp. 102–104. Gives experience in spraying for prevention of fungous diseases and for destroying insects. Advocates using fungicides and insecticides together. (J. F. J.)

526. WILLIS, J. J. **Prevention of apple scab.** Gard. Chron., 3d ser., vol. 9, No. 214, London Jan. 31, 1891, pp. 149–150, 1¼ col. Review of article by E. S. Goff in 7th Ann. Rep. of the Agric. Expt. Sta. of the Univ. of Wisconsin. (M. B. W.)

(See also Nos. 335, 341, 342, 347, 348, 349, 350, 353, 363, 365, 366, 367, 382, 385, 395, 405, 406, 409, 410, 411, 414, 415, 416, 422, 423, 425, 426, 432, 433, 434, 436, 438, 443, 449, 542, and 560.)

E.—PHYSIOLOGY, BIOLOGY, AND GEOGRAPHICAL DISTRIBUTION.

527. BEYERINCK, W. **Sur l'aliment photogène et l'aliment plastique des bactéries lumineuses.** Arch. Néerlandaises, vol. 24, 4^{me} et 5^{me} livr., Haarlem, 1891, pp. 369–442, fig. 1. An important physiological paper. The following topics are discussed: (1) A glance at the species of phosphorescent bacteria known thus far; (2) methods of research; (3) special precautions; (4) the general conditions of nutrition; (5) plastic equivalents among microbes with carbonized peptone; (6) phenomena of extinction caused by photogenic food; (7) photogenic foods and plastic foods of *Photobacterium phosphorescens.* Inactive and antiseptic matters; effect of different substances ont he luminosity and growth *Ph. phosphorescens;* (8) nutrition of *Ph. indicum* and *Ph. luminosum;* (9) theory of the luminous function; (10) does the light of the bacteria possess any biologic significance? (11) applications to the study of enzymes. (E. F. S.)

528. BOURQUELOT, EM. **Matières sucrées contenues dans les Champignons. 5. Genres Cantharellus, Ad., Russula, Pers., et Hygrophorus, Fr.** Bull. Soc. Mycol., France, vol. 7, No. 1, Paris, Mar. 31, 1891, pp. 50–52. **6. Ascomycetes.** *Ibid.*, No. 2, June 30, 1891, pp. 121–123. **Genre Agaricus, Linné (2^e ser.).** *Ibid.*, No. 3, Sept. 30, 1891, pp. 183–192. Notes the presence of mannite in *Cantharellus tubæformis* (Bull.)—young; *Cantharellus cibarius*, Fr.—dried; *Russula Queletii*, Fr.—young, adult; *Russula cyanoxantha*, (Schaeff.)—adult, dried; *Russula adusta*, (Pers.)—young; *Russula nigricans*, (Bull.)—dried; *Hygrophorus hypothejus*, Fr.—young, adult; *Hygrophorus cossus*, (Sowerb.)—young; and the presence of trehalose in *Hygrophorus hypothejus*, Fr.—young. In No. 2, pp. 183–192 notes presence of mannite in *Bulgaria inquinans* (Pers.)—young; *Peziza ochracea*, Boud—adult; *Peziza venosa* (Pers.)—adult; *Acetabula vulgaris* (Fr.)—young, adult,

dried; *Morchella semilibera* (DC.)—adult; *Elaphomyces granulatus* (Fr.)—adult; *Xylaria polymorpha* (Pers.)—dried. In No. 3, pp. 183–192 notes mannite in *Psalliota sylvicola*, Vitt.—young; *Entoloma sinuatum*, Fr.—adult; *Collybia fusipes*, Bull.—adult and dry; *Collybia dryophila*, Bull.—adult; *Clitocybe socialis*, DC.—young; *Tricholoma terreum*, Schaeff.—adult; *Armillaria mellea*, Fl.—young and adult. Trehalose was found in *Hypholoma lachrymabundum*, Fr.—young; *Pholiota mutabilis*, Schaeff.—young and adult; *Hebeloma elatum*, Batsch.—dry; *Pholiota erebia*, Fr.—young; *Pholiota togularis*, Bull.—young; *Collybia fusipes*, Bull.—young and adult; *Collybia dryophila*, Bull.—adult; *Clitocybe laccata*, Scop.—young; *Clitocybe infundibiliformis*, Schaeff.—young; *Tricholoma russula*, Schaeff.—young. (E. A. S.)

529. BOURQUELOT, EM. **Sur la présence de l'amidon dans un champignon appartenant à la famille des Polyporées le Boletus pachypus, Fr.** Bull. Soc. Mycol., France, vol. 7, No. 3, Paris, September 30, 1891, pp. 155–157. The presence of starch was shown by its reaction with iodine, both in the fungus and when extracted by boiling water; and also by its reaction with diastase. The application of iodine to sections of the fungus shows that the starch ceases at the pores. (E. A. S.)

530. BOURQUELOT, EM. **Sur la présence & la disparition du tréhalose dans l'Agaric poivré Lactarius piperatus, Scop.** Bull. Soc. Mycol., France, vol. 7, No. 1, Paris, March 31, 1891, pp. 5–9. Shows the presence of trehalose and the absence of mannite in fresh, young specimens of *Lactarius piperatus*, Scop. When the Agaric is either dried or kept in a fresh state for a few hours the trehalose disappears and mannite is found in its place. When, however, the fungus is subjected to the vapor of chloroform the trehalose is retained. (E. A. S.)

531. BOURQUELOT, EM. **Sur la répartition des matières sucrées dans les différentes parties du Cèpe comestible (Boletus edulis Bull.)** Comptes Rendus, vol. 113. Paris, Nov. 25, 1891, pp. 749–751. After some preliminary observations the author describes his method of analysis and states the grams per kilogram of saccharine matters found in fresh tissue of the various parts as follows:

	Tréhalose	Glucose
Stipe.	24.5	0.77
Pileus	13.8	0.71
Hymenium (tubes)	none.	none.

Identical results were obtained with *Boletus aurantiacus*, Bull. The analyses justify the common practice among lovers of Boleti of throwing away the tubes and explains the almost exclusive location of dipterous larvæ in the stipe. In the isolation of trehalose there is a double advantage in using only the stipes. (1) the crystallization is easier and the amount greater and (2) the fatty matter of the spores is avoided. (E. F. S.)

533. COBELLI, RUGGERO. **Contribuzione alla Flora micologica della Valle Lagarina.** Verhand. der k. k. Zool. botan. gesell. in Wien, Bd. 41, II, Quartal. Wien, July, 1891, Abh. pp. 581–584. Gives a résumé of the species of fungi reported from Valle Lagarina in two previous lists, viz: Ifunghi della Valle Lagarina Notizie preliminari, in Michelia, 1881, Patavia No. 7; and Elenco sistematico degli Imeno —, Disco —, Gastero —, Mixomyceti e Tuberacei finora trovati nella Valle Lagarina, in VII Publicazione futta per cura del civico Museo di Rovereto. Roverto, 1885. Now adds 53 species, comprising Hymenomycetes, Discomycetes, and Myxomycetes. In the two first mentioned families spore measurements are given of some species. Gives a summary of the fungi now known from Valle Lagarina as follows: Hymenomycetes, 445; Discomycetes, 49; Gastromycetes, 18; Tuberacei, 2; Myxomycetes, 12; total, 526. (W. T. S.)

534. COOKE, M. C. **Spore diffusion in Phalloidei.** Grevillea, vol. 19, London, March, 1891, pp. 84–86. Discusses the dispersion of spores of Phaloidei and Coprini, especially after passing through the stomachs of insects. Shows that there is no evidence that passage through the insect is necessary for the germination of the spore. (M. B. W.)

535. Delacroix, G. **Observations sur quelques espèces peu connues.** Bull. Soc. Mycol. France, vol. 7, No. 2. Paris, June 30, 1891, pp. 111–115. Notes the presence of paraphyses in pycnidia of *Dothiciza populea*, Sacc., *Fusicoccum populinum*, Delacr., *Fusicoccum complanatum*, Dela., *Fusicoccum pini* (Pr.), Sacc., *Stilbospora angustata* (Pers.), Sacc. Concludes that in a certain number of pycnidia or spermogonia the appearance of paraphyses follows the emission of spores, and this is perhaps the first step toward the development of the pycnidia into the ascosporous stage. Notes also the discovery of a new fruiting form of *Stephanome strigosum*, (Wallr.) Sacc., and mentions finding the spermogonia of *Uredo Mulleri*, Schrœt. (E. A. S.)

536. D'Istvánffi, Dr. Gy. **Adatok a gombák physiologiai anatomiájához.** (Études relatives à l'anatomie-physiologique des champignons) Természetrajzi Füzetek. vol. 14. Budapest, 1891 (July 10, 1891), pp. 52–67 (Fr. synopsis, 96–106), pl. 2. In higher plants four systems of tissue are distinguished—meristematic, protective, nutrient, and reproductive. The paper sums up the results of an attempt to trace the four systems in the class of fungi. (E. F. S.)

539. Gaiallard, A. **Les hyphopodies mycéliennes des Meliola.** Bull. Soc. Mycol. France. vol. 7, No. 2. Paris, June 30, 1891, pp. 99–101. Describes the opposite and alternate hyphopodies, and gives the opposite the name of capitate, and the alternate of mucronate hyhopodies. Shows that the former are undeveloped perithecia, and the latter mycelial branches arrested in their development. (E. A. S.)

540. Girard, Alfred. **Observations et experiences sur les champignons parasites de l'Acridium perigrinum.** Comptes Rend., Soc. Biol., new ser., vol. 3, Paris, June 25. 1891, pp. 493–496. Notes the fungus described in No. — as *Polyrhizium leptophyci*, also a similar fungus on different parts of the same insect and having spores arranged as in *Verticillium*. Suggests that this may be another form of the first species, but does not unite them, as there is insufficient evidence. Both are superficial fungi. Finds a white Penicillium, which is undetermined. The author also recounts an infection experiment made by inserting some of the spores of the Isaria of the white worm into the larvæ of the locust. Both the infected and the check larvæ died, but the dead bodies of the former produced a growth of the fungus when kept in a moist place. Keeping the bodies moist is, however, necessary to the appearance of the fungus, indicating that there is little hope of utilizing this Isaria or any other parasite of the same group in combating the locusts of Algeria. There are probably less chances of success with *Entomophthora grylli*, Fresen. (*E. calopteni*, Bessey), as even the few instances of apparent success need further verification. (E. A. S.)

541. Girard, Alfred. **Sur un Isaria, parasite de ver blanc.** Comptes Rend. Soc. Biol., new ser., vol. 3, Paris, April 17, 1891, pp. 236–238. In June, 1890, the author received from Ceauce (Orne) specimens of the "white worm" infested by a parasite, which proved to be an Isaria of doubtful species. It had proved very destructive to the larvæ, spreading so rapidly and killing so many as to decidedly improve vegetation over the areas where the fungus was present. Experiments showed that the spores rapidly communicated the disease to the white worm and to the larvæ of *Tenebrio molitor* both by inoculation and spraying. On artificial media the fungus was easily cultivated, even conquering other fungi that invaded the cultures. The spores retained their germinating power from October until the following March. The culture experiments were made on solid media, but experiments in growing the fungus on liquid media have been undertaken in the hope of facilitating spreading the spores over areas infested with the grubs. (E. A. S.)

542. Halsted, B. D. **Notes on Monilia fructigena and spore germination.** Bot. Gazette. vol. 16, No. 9, Sept., 1891, pp. 266, 267. Notice of paper read before Bot. Sec. Am. Asso. Agric. Col. and Ex. Sta., Aug., 1891, giving account of failure of

spores of *Monilia* to germinate in water in presence of bright metallic copper; also in one part ammoniacal solution of copper of usual strength (3 oz. to 22 gallons of water) to 99 parts of water. Suggests dilution of fungicides. (See No. 331.) (D. G. F.)

543. LINDET, L. **Les produites formés pendant la fermentation alcoolique; leur origine leur influence sur la qualité des boissons fermentées.** Rev. gén. Sci. pure et appli., 2 ann., Paris, November 15, 1891, pp. 720–723. The author mentions the following yeasts: *S. cerevisiæ, ellipsoideus, conglomeratus,* minor Engle, *Marxianus,* levure de Roux, levure caseinse. The following are destitute of endospores, but capable of inducing alcoholic fermentation: *Saccharomyces exiguus-Torula,* levure de Duclaux, *Mucor circinelloides.* Various bacteria inducing the lactic, butyric, and viscous ferments are also found in the vats; also *Myoderma vini, Bacterium aceti, B. Pastorianum,* and finally such molds as *Botrytis cinera, Penicillum glaucum, Eurotium, Dematium pullulans, Mucor racemosus,* and *M. mucedo.* The yeast is seldom pure. The stronger or more abundant organisms crowd out the weaker. Foreign organisms are likely to reassert themselves toward the close of the fermentation. These intruders may affect both the quantity and the quality of the product. The means of avoiding secondary products is discussed at some length, also the question whether this is desirable. (E. F. S.)

544. MAGNIN, ANT. **Obervations sur le parasitisme et la castration chez les anémones et les euphorbes.** Bull. Scientif. France et Belgique, vol. 23, pt. 2, Paris, August 18, 1891, pp. 412–435, pl. 1, fig. 1. Part I treats of the effect on *Anemone nemorosa* of *Puccinia fusca,* Rehl.; *Urocystis anemones,* Schroet.; *Peronospora pygmæa* Ung.; and *Synchytrium anemones,* (DC.). Wor. The teleutosporic stage of *P. fusca* causes the greatest changes, and always determines a complete castration. Part II treats of the action of the æcidium of *P. fusca* on *A. ranunculoides,* which causes a more or less complete castration manifesting itself in (1) the complete abortion of all the flowers; (2) the abortion of the lateral flowers only; (3) the more or less marked atrophy of the terminal flower, first of the carpels, then of the stamens, and finally of the sepals and the pedicels with virescence and petaloidy, and the production of a sessile staminate flower, like that sometimes observed in certain lateral flowers of healthy plants. Part III treats of the effect of *Uromyces pisi* and other species on *Euphorbia cyparissias;* of *Uromyces scutellatus,* Liv. on *E. verrucosa,* and of *Endophyllum euphorbiæsylvaticæ,* Wint., on *E. amygdaloides.* In these cases also there is ordinarily a complete castration. The paper contains a number of observations on changes in color and form exclusive of those falling strictly under the title. The author reports a peculiar secretion and a strong mellifluous odor given off by the æcida and spermogonia of *U. pisi* on *E. cyparissias* at certain hours of the day, especially on cloudy mornings. This is similar to the ordinary nectar of the floral organs and attracts insects in the same way. This odor is strong enough to be noticed at some distance and to lead to the discovery of the fungus. M. Lignier, of Caen, has also noticed "une odeur miellée excessivement intense." (E. F. S.)

545. MANGIN, LOUIS. **Sur la désarticulation des conidies chez les Peronosporées.** Bull. Soc. Bot. France, C. R. des Séances, vol. 38, Paris, 1891, pp. 176-184 and 232–236, pl. 1. See review p. 144. (E. F. S.)

546. MANGIN, L. **Revue annuelle de Botanique.** Rev. gén. Sci. pure et appli., 2 ann., Paris, April 30, 1891, pp. 255-266. Reviews Elfving's "Studien uber die einwirkung des Lichtes auf die Pilze," Helsingfors, 1890. (E. F. S.)

548. NORMAN, GEORGE. **Parasitic fungi affecting the higher animals.** Internat. Jour. Micros. and Nat. Sci., third ser. vol. 1, London and New York, July, 1891, pp. 195–204, pl. 2. After preliminary observations and historical remarks the writer treats of *Achorion* producing the disease called *Favus* on mice, dogs, rabbits, cats, fowls, and man, with descriptions and figures of the fungus

and effect on its host. *Trichophyton* is then treated in the same way. It produces the disease called ringworm in man and domestic animals and is often transmitted from animals to man. *Microsporon* is treated briefly. It is rather a rare fungus occurring only in man, producing small brown spots on the skin which do not seriously affect the patient. (M. B. W.)

549. OBERLIN. * * * **Viticulture et météorologie en 1890.** Bull. Mens. Soc. Sci. Agric. et Arts, vol. 25, Strasburg, Feb., 1891, pp. 49–52. *Peronospora viticola* appeared in August, following violent rains. It ravaged all the vineyards of Upper Alsace and if some were spared in Lower Alsace, it was not so in Lorraine. This year "this terrible parasite" appeared for the first time on the berries. Another disease of the berries supposed to be black rot appeared, also a disease of the leaves called Rauschbrand or Laubbrand and thought to be distinct from the effects of the *Peronospora*. *Oidium* was rare in 1890, the two diseases requiring different atmospheric conditions. This last statement was denied in the discussion following the reading of the paper. (E. F. S.)

550. PAMMEL, L. H. **Distribution of some fungi.** Bot. Gazette, vol. 16, No. 9, Sept. 15, 1891., pp. 261–262. Short note on paper read before Bot. Club of A. A. A. S., Aug., 1891. Discussed by L. H. Bailey. (D. G. F.)

551. PATOUILLARD, N. **Remarques sur l'organisation de quelques Champignons exotiques** Bull. Soc. Mycol. France, vol. 7, No. 1, Paris, Mar. 31, 1891, pp. 42–49, pl. 1. Gives notes on the structure and classification of *Michenera artocreas*, Berk. and Curtis, *Emericella variecolor*, Berk. and Br., *Stereum triste*, Berk. and Curt., *Hypocrea impressa*, Mont., *Hypocrea viridans*, Berk. and Curt., *Hypocrea maculæformis*, Berk. and Curt., *Crinula paradox*, Berk and Curt. The first is considered as belonging to the Uredineæ. *Emericella* is said to belong to the Ascomycetes instead of the Basidiomycetes, where it has heretofore been classified. *Stereum triste* represents a sterile form which appears to belong to the genus *Nummularia*. *Hypocrea viridans*, has all the characters of the genus *Aschersonia* and should be *A. viridans* (B. and C.) Pat. *Crinula paradox* is identical with *Cronartium asclepiadeum*, Fries, var. *quercuum*, Cooke. (E. A. S.)

552. PLANCHON, LOUIS. **Sur un cas d'empoisonnement par l'Amanita citrina, Pers.** Bull. Soc. Mycol., France, vol. 7, Paris, No. 1, Mar. 31, 1891, pp. 54–65. A detailed account by a physician of the poisoning of an entire family from eating *Amanita citrina*. Gives symptoms, treatment, and a description of the fungus. Recommends further study of the subject by physicians, and that colored drawings, together with a description of the effects of the fungus, be widely distributed among those who are unable to distinguish the poisonous and edible mushrooms. (E. A. S.)

553. SMITH, J. P. **The potato fungus.** Knowledge, vol. 14, London, July, 1891, pp. 135–137, figs. 4. Popular account giving structure and life history. (M. B. W.)

(See also Nos. 377, 388, 485, 592, 606, and 633.)

F.—MORPHOLOGY AND CLASSIFICATION OF FUNGI.

A.—GENERAL WORKS.

554. BUCKNALL, CEDRIC. **Index to Parts I–XIII of "The Fungi of the Bristol District."** Proc. Bristol Nat. Soc., new ser., vol. 6, pt. 3, pp. 425–475. An index by genera and species to 1,431 species of fungi noted in vols. II–VI, new series, followed by an index to plates. (M. B. W.)

555 COOKE, M. C. **Australian Fungi.** Grevillea, vol. 19, No. 91, London, March, June, 1891, pp. 60–62, 89–92. Descriptions of the following new species of fungi: *Trabutia phyllodiæ*, Cke. & Mass.; *Sphærella nubilosa*, *Erinnella lutea*, Phil.;

Ombrophila trachycarpa, Phil.; *Phyllosticta platylobii*, C. & M.; *Gloeosporium pestiferum*, Cke. & Mass.; *Marsonia deformans*, Cke. & Mass.; *Agaricus* (*Leptonia*) *melanurus*, Cke. & Mass.; *A.* (*Pholiola*) *disruptus*, Cke. & Mass.; *A.* (*Flammula*) *velluticeps*, Cke. & Mass.; *Boletus* (*sub-tomentosi*) *brunneus*, Cke. & Mass.; *Corticium penetrans*, Cke. & Mass.; *Didymosphæria Banksiæ*, on *Banksia; Microthyrium amygdalinum*, Cke. & Mass., on *Eucalyptus amygdalina*; *Conioporium pterospermum*, Cke. & Mass., on *Lepidospermum*; *Cercospora Kennedyæ*, Cke. & Mass. on *Kennedya prostrata; C. epicocioides*, Cke. & Mass., on *Eucalyptus; Stilbum corallinum*, Cke.& Mass.; *Aposphæria leptospermi*, on *Leptospermum; Dothiorella amygdali; Septoria lepidospermi*, Cke. & Mass., on *Lepidosperma, Melophia phyllachoroidea*, on *Leptospermum lævigatum; Leptostromella eucalypti*, Cke. & Mass., on *Eucalyptus; Gloeosporium nigricans*, Cke. & Mass., on *Eucalyptus pauciflora*; *G. citri*, Cke. & Mass., on branches of lemon.; *G. epicladii*, Cke. & Mass., on *Cladium tatraquetrum; Entyloma eugeniarum*, Cke. & Mass., on *Eugenia.* (M. B. W.)

556. ELLIS, J. B., and EVERHART, B. M. **New species of fungi from various localities.** Proc. Acad. of Nat. Sci. Phil., Part I, Phila., Jan. 13, 1891, pp. 76–93. Describes the following species as new: *Phyllosticta lycopodis*, on *Lycopus Canadensis; Ph. petasitidis*, on *Petasites palmata*; *Ph. minutissima*, on *Acer glabrum*; *Septoria pteleæ*, on *Ptelea trifoliata*; *S. nubilosa*, on *Helenium autumnale*; *Phyllosticta staphylæ*, on *Staphylea trifolia*; *Phy. rhei*, on *Rheum Rhaponticum*; *Phy-parkinsoniæ*, on *Parkinsonia aculeata*; *Phy. sophoræ*, on *Sophora speciosa*; *Cornularia ulmicola*, on *Ulmus*; *Sphæronema sphæropsoideum*, on *Fraxinus*; *Schizothyrella hippocastani*, on *Æsculus hippocastanum*; *Haplosporella seriata*, on *Sambucus*; *Vermicularia veratrina*, on *Veratrum viride*; *Sphæropsis ulmicola*, on *Ulmus*; *Diplodia papillosa*, on *Cornus*; *D. linderæ*, on *Lindera Benzoin*; *D. Dearnessii*, on wild *Ribis*; *Leptostromella elastica*, on *Ficus elastica*; *Septoria gummigena*, on hardened gum of cherry trees; *S. dolichospora*, on *Solidago latifolia; S. carnea*, on dead leaves of *Carex*; *S. erechtitis*, on *Erechtites hieracifolia*; *S. Canadensis*, Ell. & Davis, on *Solidago Canadensis*; *S. albicans*, on *Saxifraga Pennsylvanica*; *Phleospora reticulata*, on *Lathyrus palustris*; *Stagonospora petasitidis*, on *Petasites palmata*; *St. cyperi*, Ell. & Tracy, on *Cyperus cylindricus*; *St. trifolii*, on *Trifolium repens*; *Coryneum paspali*, on *Paspalum patycaule*; *Gloeosporium caryæ*, Ell. & Dearness, on *Carya alba*; *Gl. celtidis*, on *Celtis occidentalis*; *Gl. lunatum*, on *Opuntia*; *Gl. saccharinum*, on *Acer saccharinum*; *Gl. Canadense*, on *Quercus alba; Gl. ovalisporum*, on *Prunus serotina; Cylindrosporium ziziæ*, on *Zizia cordata; Cy. Dearnessii*, on *Carpinus Americana; Cy. cicutæ*, on *Cicuta maculata; Cy. ceanothi*, on *Ceanothus thyrsiflorus; Marsonia nigricans*, on *Salix; M. apicalis*, on *Salix lucida; Ramularia Canadensis*, on *Carex conoidea; R. stolonifera*, on *Cornus stolonifera; R. arnicalis*, on *Arnica cordifolia; R. repens*, on *Aralia racemosa; R. dioscoreæ*, on *Discorea villosa*; *R. lethalis*, on *Acer rubrum*; *Peronospora impatientis*, on *Impatiens fulva; Titæa Clarkei*, on *Dichæna strumosa*, growing on *Quercus ilicifolia; Rhinotrichum muricatam*, on decaying bark; *Zygodesmus tuberculosus*, on decaying roots; *Zy. limoniisporus*, on rotten maple; *Coniosporium subgranulosum*, on decorticated poplar; *Fusicladium angelicæ*, on *Angelica atropurpurea; Clasterisporium dothideoides*, on *Shepherdia argentea* and *Artemisia cana*; *Cercospora kalmiæ*, on *Kalmia latifolia*; *C. pachyspora*, on *Alisma plantago* and *Peltandra Virginica; C. cæspitosa*, on *Eustachys petræa* and *Chloris Swartziana; C. Davisii*, on *Melilotus alba*; *C. houstoniæ*, on *Houstonia cærulea*; *C. osmorrhizæ*, on *Osmorrhiza longistylis*; *C. acnidæ*, on *Acnida cannabina*; *C. negundinis*, on *Negundo aceroides; C. senicionis*, on *Senecio aureus; C. infuscans*, on *Rhus venenata*; *C. comandræ*, Ell. & Dearness, on *Comandra umbellata*; *C. mikaniæ*, on *Mikania scandens*; *C. Halstedii*, on *Carya tomentosa*; *C. medicaginis*, on *Medicago denticulata; C. lathyrina*, on *Lathyrus latifolius; Cercosporella pyrina*,

on *Pyrus coronaria; Fusicladium effusum*, var. *carpineum*, on *Carpinus Americana; Clasterisporium cornigerum*, on *Carpinus* sp.; *Dendryphium muricatum* on *Prunus Virginiana; D. pachysporum*, on *Peniophora; Septonema grisco-fulvum* on *Populus tremuloides; Sporidesmium tabacinum*, on *Populus tremuloides; Macrosporium podophylli*, on old *Æcidium podophylli; Helicosporium diplosporum* on *Smilax; Fusarium volutella*, on *Vitis bipinnata; Epidochium olivaceum* on *Fraxinus* sp.; *Exosporium sociatum*, on *Rhytisma acerinum*, growing on *Acer rubrum*. (D. G. F.)

557. Farlow, W. G., and Seymour, A. B. **A provisional host index of the fungi of the United States, Part III.** Cambridge, June, 1891, pp. 135–219. Includes in this third and last part the hosts Endogens, Cryptogamia, and animals, together with an addenda of 29 pages and an index of genera. See No. 126 and review in this Journal, (vol. 7) p. 135. (D. G. F.)

558. Grove, W. B., and Bagnall, J. E. **The fungi of Warwickshire.** (Cont. from Vol. XIII, p. 282.) Midland Naturalist, new ser., vol. 14, Birmingham, Jan., Mar., Apr., May, June, Aug., Sept., Oct., 1891, pp. 20–24, 63–66, 93–95, 115–117, 135–138, 190–192, 209–211, 236–238. A list with habitats and brief notes, including Agaricini, Polyporei, Hydnei, Thelephorei, Clavarei, Tremellinei, Trichogastres, and Nidulariacei. (M. B. W.)

559. Hauer, Dr. Franz Ritter von. **Jahresbericht für 1890.** Annalen des K. K. Natur. Hofmuseums, Band 6, No. 1, Wien, May, 1891, Notiz, 1–87, Section b. Botanische Abtheilung, pp. 23–27. Mentions the placing in the exhibition collection of very large specimens of *Peziza coronaria*, Jacq., *Polyporus frondosus*, and other fungi, lichens, etc. (W. T. S.)

560. Kellerman, W. A. **Parasitic plants.** Cult. and Country Gent., 61st year, No. 2025, Albany, Nov., 1891, p. 936, ½ col. Brief statement of what fungi are and how they attack cultivated plants. Mentions methods of combating diseases. (J. F. J.)

561. Marquand, E. D. **The cryptogamic flora of Kelvedon and its neighborhood, together with a few coast species.** Compiled from the herbarium and notes made by the late E. G. Varenne, M. R. C. S. Essex Naturalist, Chelmsford, April, 1891, pp. 1–30. Contains a list of lichens (208 species) and of fungi (136 species) including Agaracini, Uredineæ, Peronosporeæ, and Erysipheæ; no hosts given for the parasitic forms. (M. B. W.)

562. Massee, George. **New fungi from Madagascar.** Journ. of Bot., vol. 29, No. 337, London, Jan., 1891, p. 1–2, pl. 1. Describes the following new genus and species: *Mycodendron* n. gen., *M. paradoxa, Agaricus* (*Clitocybe*) *pachycephalus, Bulgaria trichophora, Cenangium congestum*, with figures of each. (M. B. W.)

563. Passerini, G. **Diagnosi di funghi nuovi, Nota V.** Atti Reale Accad. Lincei, 4th ser., vol. 7, fasc. 2, 2 Sem., communicazioni pervenuta all 'Accad. sino al 19 luglio 1891, Rome, pp. 43–51. Descriptions of following new species: *Protomyces miscrosporus*, on leaves of *Jasminum sambac; Anthostomella Quercus*, on dry twigs of *Quercus; Laestadia Spartii*, on dead branches of *Spartium junceum; Wallrothiella pusilla*, on rotten trunks; *Sphærella alba*, on languishing leaves of *Populus alba; Epicymatia Modoniæ*, on *Stilbospora Modonia* on dead branches of *Castanea vesca; Melanopsamma rosæ*, on decayed branches of Rose; *Leptosphæria camphorata*, on dry stems of *Artemisia camphorata; L. faginea*, on dead twigs of Beech; *L. punctiformis*, on decayed stems of *Zea Mays; L. vaginæ*, on decaying sheaths of *Phragmites vulgaris; Melanomma leptosphærioides*, on dry naked stems of *Pulicaria viscosa; M. epileucum*, on old bark of *Ulmus campestris; Massarina microspora*, on dead branches of *Pinus sylvestris; Metasphæria spurca*, on dry umbelliferous stems, perhaps *Daucus Carota; M. clavulata*, on decayed culms of *Scirpus Holoschænus; Pleosphærulina* gen. n. *P. rosicola*, on dry branches of *Rosa canina; Zignœlla ligustrina*, on dry branches of *Ligustrum vulgare*, together with *Ostropa cinerea; Pleospora verbenicola*, on dry stems of *Verbena officinalis; Curreya ulmicola*, on decayed branches of *Ulmus*

montana; Lophiostoma clavulatum, on dry branches of *Spartium junceum; Ocellaria pulicariæ*, on dry stems of *Pulicaria viscosa; Phoma pulicariæ*, on branchlets of *Pulicaria viscosa; Phyllosticta advena*, on languishing leaves of *Rhamnus corymbosus;* cult. in garden under name of *Guevina Avellana; Ph. ulmaria*, on leaves of *Ulmus campestris; Ph. cinerea*, on languishing leaves of *Populus alba; Phoma cladophilia*, on dead branches of *Elæagnus reflexa; Ph. pycnocephali*, on dead stems of *Carduus pycnocephalus; Ph. lichenis*, on sterile thallus of some lichen, perhaps *Parmelia pulverulenta*, on branches of *Fraxinus; Macrophoma cylindrica*, on dead branchlets of *Pulicaria viscosa; Aposphæria leptosphærioides*, on dead stems of *Pulicaria viscosa; Coniothyrium tuberculariæ*, on sporodochia of a species of Tubercularia on branches of *Calycanthus præcox; Diplodia carpogena*, on decaying pericarp of *Æsculus Hip, pocastanum; D. rhodophila*, on dry branches of cultivated rose; *D. microsporella*, Sacc., var. *cordiæ*, on dead branchlets of *Cordia Myxa; D. australis*, on dead branchlets of *Celtis australis; D. emphisphærioides*, on oak bark; *Botryodiplodia æsculina*, on dead branches of *Æsculus Hippocastanum; Ascochyta decipiens*, on stems and branches of *Antirrhinum majus; Hendersonia subcorticia*, on detached and still hanging bark of *Pirus malus; H. candida*, on languishing leaves of *Populus alba; Dichomera persicæ*, on cut off stump of peach; *Rhabdospora jasmini*, on frozen branches of *Jasmium officinalis; Rh. lagerstroamiæ*, on denuded dry branches of *Lagerstræmia Indica; Rh. muhlembeckiæ*, on branches of *Muhlembeckia complexa; Pleococcum Holoschoeni*, on dead stems of *Scirpus Holoschoenus; Glœosporium cerei*, on *Cereus triangularis; Pestalozzia* (*Pestalozziana*, sub gen. nov.) *artemisiæ*, on dry stems of *Artemisia camphorata; Coniothecium cupulariæ*, on dry stems of *Inula viscosa; Speira ulicis*, on dry branches of *Ulex Europæus; Tubercularia calycanthi*, on dead branches of *Calycanthus præcox; T. rhodophyla* [sic.], on dead branches of cultivated rose; *Fusarium robiniæ*, on fallen branch of *Robinia pseudacacia; F. celtidis*, on dead branches of *Celtis australis; Chætostroma Holoschoeni*, on decayed leaves of *Scirpus Holoschoenus*. (W. T. S.)

564. PECK, CHARLES H. **Annual report of the state botanist of the state of New York.** 44th Report N. Y. State Mus. Nat. Hist., Albany, 1891, pp. 75, l. 4, pl. 4. Contains descriptions of many new species of fungi both by himself and Mary E. Banning. The last are in a manuscript volume of the Fungi of Maryland, illustrated by colored plates. The genus Tricholoma of New York is monographed in the same manner as genera in previous reports. For notice see under head of Reviews, this JOURNAL, (vol. 7) p. 147. (J. F. J.)

565. SACCARDO, P. A. **Sur les règles à suivre dans la description des espèces végétales et surtout des cryptogames.** Bull. Soc. Mycol., France, vol. 7, Paris, June 30, 1891, pp. 73–75. Gives a digest of rules to be used in describing fungi. They relate to modes of expression, language, citation of authority, writing of measurement, expression of scientific names, standard of colors, and names for the fruit of different groups. (E. A. S.)

566. SOMERS, J. **Nova Scotian fungi.** Proc. and Trans. Nova Scotian Inst. Nat. Sci., vol. 7, pt. 4, Halifax, 1890, issued 1891, pp. 464–466. Contains enumeration of fungi of Nova Scotia begun in vol. 7, part I, p. 18 of Transactions. Gives 16 species, none new. (D. G. F.)

See also No. 644.

B.—CHYTRIDIACEÆ.

567. FISCHER, DR. ALFRED. **Phycomycetes.** Rabenhorst's Kryptogamen-Flora, Band I, Abth. IV, Pilze: Lief. 45, 46, 47. Leipzig, 1892 (1891), pp. 1–192, many figs. See review this journal, (vol. 7) p. 135. (E. F. S).

See also Nos. 371, 423 544.

C.—OÖMYCETES.

568. HALSTED, B. D. **Notes upon Peronosporeæ for 1891.** Bot. Gaz., vol. 16, No. 12, Dec. 15, 1891, pp. 338–340. Gives notes on the following species: *Phytophthora infestans*, *Sclerospora graminicola*, *Plasmopara viticola*, *Plasmopara pygmæa*, *Plasmopara geranii*, *Bremia lactucæ*, *Peronospora parasitica*, *Peronospora Cubensis*, *Peronospora effusa*, *P. potentillæ*, *Cystopus Ipomæ panduratæ* [sic.], *C. candidus*, *C. portulacæ*. Notes *Alyssum maritimum* as new host for *P. parasitica*: and *Potentilla grandiflora* as new host to the country for *P. potentillæ*. (D. G. F.)

569. MASSALONGO, C. **Sull' alterazione di colore dei fiori dell' Amarantus retroflexus infetti dalle oospore di Cystopus Bliti, D'By.** Nuovo Giorn. Bot. Ital., vol. 23, No. 1, Firenze, 8 gennaio 1891, pp. 165-167. Records the finding of oöspores of *Cystopus bliti* D'By. in inflorescenses of *Amarantus retroflexus*. The flowers attacked assume a more or less pronounced red color and are thus rendered more conspicuous. The author suggests that the oöspores formed in these reddish flowers are perhaps distributed by animals, while those occurring as usual in leaves are distributed by the wind; suggests also that here is an analogy to heterocarpism in higher plants, except that the difference between the oöspores is not a morphological one, but simply one of different comportment in regard to the organs of the host plant attacked. (W. T. S.)

570. SPEGAZZINI, CAROLUS. **Phycomycetes Argentinæ.** Revista Argentina de Hist. Nat., vol. 1, Buenos Aires, Feb., 1891, pp. 28–38. Gives list of species of Phycomycetes, and describes new species as follows: *Mucor mucedo* var. *a b*, *M. platensis*, *Cystopus platensis*, on leaves of *Bœrhaavia hirsuta*, *Chlospora* n. gen., *C. vastatrix*, in bulbs of *Allium coepæ*; *Peronospora nicotianæ*, on leaves of *Nicotiana longiflora*. The species in the list, 37 in all, are accompanied by notes on hosts, measurements of spores, etc. (J. F. J.)

(See also Nos. 371, 377, 545, and 567.)

D.—ZYGOMYCETES.

(See Nos. 543, 567 and 570.)

E.—BASIDIOMYCETES.

571. ALLEN, A. and SPIERS, W. **British Agaricini.** Internat. Jour. Micros., and Nat Sci., 3d ser., vol. 1, London and New York, Aug., 1891, p. 233, 7 lines. Notes that there are 1,400 species in the British Isles, 134 edible and 30 poisonous. (M. B. W.)

572 COOKE, M. C. **Additions to Dædalea.** Grevillea, vol. 19, No. 92, London, June, 1891, pp. 92–93. Descriptions of five new species of *Dædalea* from Herb. Berk., *D. Eatoni*, Berk., *D. subcongener*, Berk., *D. flabellum*, Berk., *D. Andamanni*, Berk., *D. Mulleri*, Berk. (M. B. W.)

573. COOKE, M. C. **Additions to Merulius.** Grevillea, vol. 19, June, 1891, p. 108–109. Describes as new *Merulius sordidus*, B. & C., *M. rimosus*, Berk. in herb., *M. pelliculosus*, and states that *M. pallens*, Schwein. (not of Berkeley), is the same as *M. corinum*; and *M. terrestris*, B. & Br. (undescribed), is the same as *M. brassicæfolius*. (M. B. W.)

574. COOKE, M, C. **A new subgenus of Agaricus.** Grevillea, vol. 19, June, 1891, pp. 104–405. Describes the new subgenus *Metraria* founded on a species from Australia, which is also described; *Agaricus* (*Metraria*) *insignis*, C. & M. (M. B. W.)

575. COOKE, M. C. **British Thelephorei.** Grevillea, vol. 19, March, 1891, pp. 64–67. Synopsis of the genus *Stereum* with descriptions of the species. (M. B. W.)

6. COOKE, M. C. **Favolus and Laschia.** Grevillea, vol. 19, No. 92, London, June, 1891, p. 105. Original description of the following species from herb. Berkeley. *Favolus subgelatinosus*, Berk., *Laschia decurrens*, Berk. & C., *L. flabellula*, B. & C. in herb., *L. lurida*, Cesati, in Myct. Bon., *Glœosporus corrugatus*, Berk. (M. B. W.)

7. COOKE, M. C. **Irpex addenda.** Grevilea, vol. 19, No. 92, London, p. 109. Describes the following new species: *Ipex decurrens*, Berk. in herb., *I. crispatus*, Berk. in herb., *I. modestus*, Berk., in herb., *I. clathratus*, Berk. in herb., *I. decolorans*, B. &. C. in herb. (M. B. W.)

8. COOKE, M. C. **Lachnocladium.** Grevillea, vol. 19, No. 92, London, p. 93. Note on affinities. (M. B. W.)

9. COOKE, M. C. **Some omitted diagnoses.** Grevillea, vol. 19, No. 92, London, pp. 103–104. Description of fungi omitted from Saccardo's Sylloge: *Agaricus (Inocybe) holophlebius*, Berk., in herb., *Thelophora griseozonata*, Cke. Rav. Fun. Amer. No. 444. (M. B. W.)

80. COOKE, C. M. **Species of Hydnei. Additimenta to Saccardo's Sylloge.** Grevillea, vol. 20, No. 93. Sept., 1891, pp. 1–2. Describes the following new species: *Hydnuum peroxydatum*, Berk., *H. analogum*, Berk. in herb., *H. cohærens*, B. & C., *H. scariosum*, B. & Br., *H. lachnodontium*, Berk., *H. Liriodendri*, B. & C. in herb., *H. artocreas*, B. & C. in herb., *H. Agressii*, Berk. in herb. with notes on *H. microdon*, Pers., *H. Berkeleyi*, Curtis, *H. alliceps*, Berk. & Rav., *H. herbicolum*, Ellis, *H. trechodontium*, Berk., and states that *H. luteo-virens* appears to be an *Irpex*. Eight species of *Radulum* are mentioned; *R. Emerici*, Berk. and *R. Neilgherrensis*, Berk. in herb., are described. Five species of *Phlebia* are mentioned, of which *P. spilomea*, Berk. & Curt., and *P. deglubens*, Berk. and Curt., are described. *Odontia albominiata*, B. & C., is said to be *Hydnum cinnabarinum*, Schwein., and *O. scopinella*, Berk., not a *Hydnum*, as described in Sacc. Syll. *Kneiffia tinctor*, Berk. in herb., and *K. subtilis*, Berk, in herb., are described as new, and *K. typhæ*, Berk. in herb., said to be *Corticium typhæ*. (M. B. W.)

581. COOKE, M. C. **Trametes and its allies.** Grevillea, vol. 19, No. 92, June, 1891, pp. 98–103. Divides the genus as treated in Saccardo's Sylloge into sections, giving a list of the species in each; five species have been transferred to the genus *Sclerodepsis* in a previous number. The following are described for the first time: *Trametes Dickinsii*, Berk. in herb., *T. gausapata*, Berk. and Rav. in herb. *T. Burchelli*, Berk. in herb., *T. adelphica*, *Hexagonia laevis*, Berk. in herb., *Hexagonia tenius*, Hook. var. *subtenuis*, Berk. in herb. (M. B. W.)

582. COOKE, M. C. **Two Australian fungi.** Grevillea, vol. 19, No. 91, Mar. 1891, pp. 81–83). Describes as new *Agaricus (Amanita) strobilaceus* and *Lasiosphæria larvaespora*, Cke. and Mass. (M. B. W.)

583. COOKE, M. C. **Two Japanese edible fungi.** Grevillea, vol. 19, No. 91, Mar., 1891, pp. 62–64. Reprints an article by Mr. N. Tanaka in the Botanical Magazine of Japan, in which two new species of *Lactarius* are described, *L. Hatsudake* and *L. Akahatsu*. (M. B. W.)

584. [CRANE, D. C.] **Growing mushrooms in winter.** Rept. N. J. State Board Agric., vol. 18, Trenton, 1891, pp. 478–479. Refers to experiments of a farmer near Elizabeth, N. J., in raising mushrooms, describing the hotbed. No results mentioned. (J. F. J.)

585. DE SEYNES, J. **Conidies de l'Hydnum coralloides, Scop.** Bull. Soc. Mycol. France, vol. 7, Paris, June 30, 1891, pp. 76–80, figs. 8. Describes conidia of *Hydnum coralloïdes*, Scop., and compares them with the normal tetraspores, and with conidia of *Hydnum erinaceus*, Bull., and *Polyporus biennis*, Bull. The conidia are endocellular and of two kinds. (E. A. S.)

586. FLORIDA AGRICULTURIST. **Underground oranges.** Fla. Agriculturist, vol. 18, No. 47, De Land, Dec. 2, 1891, p. 651. Notes determination of peculiar underground bulbs resembling oranges as really *Phallus impudicus*. (D. G. F.)

587. GODFRIN, J. **Contributions à la flore mycologique des environs de Nancy. Catalogue méthodique des Champignons Basidiés récoltes en 1889–'90.** Bull. Soc. Mycol. France, vol. 7, Paris, June 30, 1891, pp. 124–136. A catalogue of [illegible] Hymenomycetes. (E. A. S.)

588. HENNINGS P. **Note micologiche.** Malpighia, anno V. fasc. 1–2, Genova, 18[illegible], pp. 89. Part I consists of following corrections of some errors regarding some *Polyporeæ* collected by Balansa in 1884 in Paraguay, and for the most part described as new by Spegazzini. *Hexagona Friesiana*, Speg., F. guar. Pug. I. p., 55 = *Polyporus umbonatus*, Fr., *Thelophora (Craterellus) spassoides*, Speg. l. c., p. 69 = *Polyporus Warmingii*, Berk., *Polyporus sub tropicalis*, Speg., = *P. gilvus*, Fr., *P. subgilvus* Speg., = *P. gilvus*, Fr., *P. Landii*, Fr., = *P. occidentalis* Kalch., *P. Drummondii*, Klotzsch forma *setulosa* Speg., = *P. versalilis*, Berk. In part II. of the paper the following new species and varieties are described: *Æcidium Aschersonianum*, on leaves of *Kundmannia sicula* from Malta; *Uromyces Schweinfurthii*, on branches of *Acacia Ehrenbergiana* from Arabia Felix: *Schroeteria Cissi*, (DC.) De T., var. *Arabica*, on petioles and branches of *Cissus quadrangularis* from Arabia Felix. (W. T. S.)

589. MASSEE, GEORGE. **New or imperfectly known Gastromycetes.** Grevillea, vol. 19, No. 92, London, June, 1891, pp. 94–98. Describes the following new species and new genera. *Mutinus fraxinus*, Berk. in herb. *Crucibulum simile*, *Tulostoma Wrightii*, Berk. in herb. *T. album*, *Hydnangium Tasmanicum*, Kalchbr. in herb. *Secotium leucocephalum*, *S. Gunnii*, Berk. in herb. *Gyrophragmium Texense* (B. & C.), Mass., *Calostoma æruginosa*, *Protoglossum*, nov. gen., *P. luteum*, *Gymnoglossum*, nov. gen. *G. stipitatum*. (M. B. W.)

590. [?MASTERS, M. T.] **Mushrooms.** Gard. Chron., 3d ser., vol. 10, London, September 26, 1891, p. 368, one-half col. Describes a method of culture. (M. B. W.)

591. OLIVIER, ERNEST. **Les ronds de sorciers.** Rev. scientif., Bourbonnais, 4e ann., Moulins, August 15, 1891, p. 170. Describes the appearance of sorcerers rings in meadows in June. These often persist several years, and increase in size to the vexation of the farmer. The grass in the interior of the ring is yellow, but that on the exterior, over a breadth of 20–30 centimeters, is always remarkably green and vigorous. These rings are due to *Agaricus campestris*, etc. (E. F. S.)

592. PATOUILLARD, N. **Polyporus bambusinus, noveau polypore conidifère.** Bull. Soc. Mycol. France, vol. 7, Paris, June 30, 1891, pp. 101–103. Describes the new species, *Polyporus bambusinus* under three forms dimidiate, nodulose, and resupinate. The first and third have a conidial fructification, and neither normal basidia nor cystidia can be found in the resupinate form. (E. A. S.)

593. ROLLAND, LÉON. **Essai d'un calendrier des Champignons comestibles des environs de Paris.** Bul. Soc. Mycol. France, vol. 7, Paris, March 31, 1891, pp. 10–14, pl. 2. Describes external appearance, and gives habitat and date of *Paxillus involutus*, (Batsch) Fr., *Lepiota procera*, Scop. *Lactarius volemus*, Fr. *Lactarius deliciosus*, (L.) Fr. *Lactarius rufus*, (Scop.) Fr. (E. A. S.)

594. ROLLAND, LÉON. **Excursions mycologiques dans les Pyrénées et les Alpes-Maritimes.** Bull. Soc. Mycol. France, vol. 7, Paris, June 30, 1891, pp. 84–97. Gives lists of fungi collected at Cauterets and in the province of Var on the shores of the gulf Juan. The following new species are described: *Omphalina bibula* Cuel., var. *citricolor*; *Tricholoma saponaceum*, var. *lavedana*.; *Blitrydium caryestiæ*, de Not, *Ceratostoma phœnicis*. (E. A. S.)

595. ROLLAND, LÉON. **Une visite au Musée Barla.** Bull. Soc. Mycol. France, vol. 7, Paris, March 31, 1891, pp. 66–72. Describes M. Barla's collection of plaster casts of fleshy fungi at Nice, and gives a catalogue of a large number of the species modeled. In a footnote are given detailed directions for making the models. (E. A. S.)

596. SMITH, J. P. **The mushroom.** Knowledge, vol. 14, 73, London, November 2, 1891, figs. 6. A popular account of *Agaricus campestris*, with description of its anatomy and life history. (M. B. W.)

597. SPEGGAZINI, CAROLO. **Fungi guaranitici nonnulli novi v. critici.** Revista Argentina Hist. Nat., vol. 1, Buenos Aires, April, 1891; pp. 101–111, June, 1891, pp. 168–177. Notes on Hymenomycetes describing the following new species: *Marasmius balansæ, Poria subargentea, Favolus elegantissimus, F. dædaleoides, F. Harioti, Pterula humilis.* The species, 31 in all, are accompanied by notes and diagnostic characters. Part 2 mentions various species of Hymenomycetes, Gastromycetes, Myxomycetes and Hyperdermeae. The following are described as new species: *Lanopila guaranitica, Ustilago juncicola* in ovaries of *Juncus Chamissoni, Entyloma nectrioides* on leaves of a species of *Leguminosæ, Puccinia chloridis* on leaves of *Chloriis* sp., *P. macrocephala* on leaves of *Convolvulaceæ, Uromyces ? cyperinus* on leaves of *Cyperaceæ, U. æruginosus* on leaves of *Sapindaceæ* (?), *Uredo carnosa* on leaves of *Orchidaceæ.* Notes are given on other species. (J. F. J.)

598. TAYLOR, THOMAS. **Mushrooms of the United States.** U. S. Dept. Agric., Rept. for 1890, pp. 366–373, pl. 5. Gives colored figures of eight edible and twelve poisonous mushrooms. Gives directions for the culture of various species, with figures of houses and beds for their cultivation. Also various recipes for their preparation for the table. Issued as a reprint with the title "Food Products; eight edible and twelve poisonous mushrooms of the United States, with directions for the culture and culinary preparation of the edible species." pp. 16, pls. 5. (D. G. F.)

599. ZOPF, W. **Ueber die Flora und die Vegetation Spitzbergens—3 Thallophyten.** Naturwissens. Wochenschr., vol. 6, Berlin, Dec. 13, 1891, p. 508. Notes the occurrence of *Lycoperdon furfuraceum*, Schaeff. (J. F. J.)

(See also Nos. 334, 336, 337, 445, 528, 529, 530, 531, 562, 614, and 637.)

F.—UREDINEÆ.

600. ARTHUR, J. C. **Notes on Uredineæ.** Bot. Gazette, vol. 16, No. 8, Aug. 15, 1891, pp. 225–227. Discusses synonomy of *Puccinia stipæ*, considering the publication of the species in 1884 by the author as prior to collection by Hora of the identical species named by Opiz in 1852. Prefers *Puccinia stipæ* (Opiz) Arthur, as correct writing of the name. Draws attention to the name *Puccinia ornata*, Harkness, as being preoccupied, and suggests the name *P. medusæoides.* [It may be remarked, however, that Harkness's species, *P. ornata* was previously described by Winter as *P. appendiculata* on Bignoniaceous plant from Mexico. See Sacc. Sylloge, vol. 7, part 2, p. 727, No. 2552.] Points out an error in the measurement of the teleutospores of *Uromyces perigynius*, Halsted, making their true dimensions 12–18 x 24–30*v*. Mentions work of Dietel in Hedwigia, vol. 28 (1889), p. 22, demonstrating *Uromyces caricis*, Peck, to be the uredo of *Puccinia caricis-strictæ*, Dietl. Reports the discovery of the uredospores of *Uromyces perigynius* and teleutospores of *Coleosporium viburni.* Describes *Puccinia cyperi* n. sp. on *Cyperus Schweinitzii*, and *C. strigosus; Uromyces gentianæ* n. sp. on *Gentiana quinquefolia* var. *occidentalis.* (D. G. F.)

601. ATKINSON, GEO. F. **A new Ravenelia from Alabama.** Bot. Gazette, vol. 16, No. 11, Nov., 1891, pp. 313–314. Describes as new *Ravenelia cassiæcola*, upon stems, leaves and pods of *Cassia nictitans.* Considered specifically distinct from *R. stictica*, Berk. & Br., No. 554, Myc. Univ., *R. glandulæformis*, Berk. & Curt., No. 1251, Myc. Univ., and *R. texanus*, Ell. & Galw. (D. G. F.)

602. COCKERELL, T. D. A. **Additions to the fauna and flora of Jamaica.** Jour. Insti. Jamaica, vol. 1, Kingston, Nov., 1891, p. 32. *Uredo Vialæ*, Lagerheim, on vine leaves, is reported from near Rockport. (E. F. S.)

603. GRAZIANA, A. **Deux champignons parasites des feuilles de coca.** Bull. Soc. Mycol. France. vol. 7, Paris, Sept. 30, 1891, pp. 152–153, pl. 1. Describes *Uredo erythro-*

xylonis on *Erythroxylon coca* from Peru and Bolivia, and *Phyllosticta erythroxylonis* on the same host from Bolivia. (E. A. S.)

(See also, Nos. 401, 402, 418, 445, 544, 588, and 597.)

G.—USTILAGINEÆ.

(See Nos. 402, 558 and 597.)

H.—ASCOMYCETES.

I.—*Gymnoasci.*

(See No. 432, 445.)

II.—*Perisporiaceæ.*

604. CHATIN, A. **Contribution à l'histoire botanique de la truffe, Kammé de Damas (Terfezia Claveryi).** Comptes Rendus, vol. 113, Paris, Sept. 14, 1891, pp. 381–384. The author had previously described a var. *arabica* of *T. boudieri*, and now finds a new species which is widely distributed. It is a remarkable species and represents the type of the section characterized by reticulate and non-verrucose spores. The weight of the tubers averages 50 to 130 grams. (E. F. S.)

605. CHATIN, A. **Contribution à l'histoire botanique de la truffe (Quatrième note)—Kamés de Bagdad (Terfezia Hafizi et Terfezia Metaxasi) et de Smyrne (Terfezia leonis).** Comptes Rendus, vol. 113, Paris, Oct. 26, 1891, pp. 530–534. As in case of the Terfas of Algeria, the kamé of Smyrna is eaten mixed with meat and eggs and cooked in butter or oil. A study of the immature spores of this species shows that *T. boudieri* is distinct, and not an immature form of *T. leonis*, as Tulasne conjectured. The latter occurs also in Sicily, near Naples, and in Spain. (E. F. S.)

606. CHATIN, A. **Contribution à l'histoire naturelle de la truffe—Parallèle entre les Terfas ou Kamés (Terfezia Tirmania) d'Afrique et d'Asie et les truffes d'Europe.** Comptes Rendus, vol. 113, Paris, Nov. 2, 1891, pp. 582–586. Discusses geographical distribution, climate, soil, host plants, time of maturity, depth in the soil, mode of gathering, culture, color, odor, taste, periderm, flesh or gelba, sporangia, spores, and chemical composition of truffles and terfazias. The latter are essentially African and Asiatic, fungi of hot climates, and are only represented in Southern Europe. Both prefer soils rich in lime and oxide of iron. Truffles grow at depths of 10–15 cm., but sometimes 40–50 cm. They rarely approach so near the surface as to lift the earth, but this is common in case of Terfazias, which are even found, growing partly out of the soil or under leaves. Truffles are generally parasitic on trees; Terfazias, on under shrubs, such as Cystineæ, or apparently even on annuals like Helianthus. Terfazias cover immense districts. They are gathered and dried by the Arab population, to whom they hold the same place as the potato to the Irish peasant. They contain less nitrogen and phosphorus than truffles, but are superior in this respect to potatoes. The yearly value of the Perigord truffle (*Tuber melanosporum*) exceeds 20,000,000 francs. (E. F. S.)

607. CHATIN, A. **Contribution à l'histoire botanique de la truffe (Kamés de Bagdad).** Rev. des Sci. Nat. et Appli., vol. 38, Paris, Nov. 20, 1891, pp. 582–584. Brief account of two truffles received in 1891 from M. Metaxas, of Bagdad, and referred to the genus *Terfezia*. One is described as *T. Hafizi*, n. sp., and the other is *T. Metaxasi*, n. sp. The author believes this genus will be found to be represented by as many species in the desert regions of Asia and Africa as is *Tuber* in the more temperate countries of Europe. (E. F. S.)

608. GAILLARD, A. **Observations d'un retour à l'état végétatif des Perithèces dans le genre Meliola.** Bull. Soc. Mycol. France, vol. 7, Paris, Sept. 30, 1891, pp. 151-152. Notes the fact that certain perithecia remain paler and smaller than others. These are sterile and their cells grow out into long mycelial filaments. (E. A. S.)

609. KNOWLES, H. G. **Truffles.** Repts. from consuls of U. S., No. 132, Sept., 1891, pp. 158–160. Considers truffles due to sting of insect. Notes method of hunting for them by pigs in France and describes training of dogs for the same purpose. Gives value of 452,361 pounds exported from France in 1889 at $476,147. Explains method of canning. (J. F. J.)

610. [? MASTERS, M. T.] **A Syrian Truffle.** Gard. Chron., 3d ser., vol. 10, London, Nov. 21, 1891, p. 617, ⅛ col. Notes that M. A. Chatin has described a peculiar truffle in Comptes Rendus. (See No. 604.) (M. B. W.)

(See also No. 445 and 637.)

III.—*Sphæriaceæ.*

611. ATKINSON, GEO. F. **On the structure and dimorphism of Hypocrea tuberiformis.** Bot. Gazette, vol. 16, Oct., 1891, pp. 281–284, pl. 1. Describes the ascigerous, sphacelial, and stromatous forms of the fungus, placing it in the genus *Hypocrella* of Saccardo. Considers the species distinct from *Dussiella* of Patouillard, and shows the near relation existing between the genera *Epichloe* and *Hypocrella.* Points to separation of the genera on ground of inclosure or non-inclosure of culm of host by the stroma of the fungus as a trifling one, and cites case of *Hypocrella,* which surrounds opening buds of *Andropogon Virginicus* as torn asunder by opening of the buds. Paper read before Bot. Club of Am. Asso. Adv. Sci., Aug., 1891. (D. G. F.) See notice in *Ibid.*, Sept. 1891, p. 256.

612. ATKINSON, GEO. F. **Sphærella gossypina, n. sp., the perfect stage of Cercospora gossypina, Cooke.** Bull. Torrey Bot. Club, vol. 18, Oct., 1891, pp. 300–301, pl. 1. Gives paper read before the Bot. Club of the Am. Asso. for Advancement of Science, Washington, Aug., 1891, describing *Sphærella gossypina*, n. sp., found very abundant upon leaves of *Gossypium herbaceum* attacked by *Cercospora gossypina.* Considers the *Sphærella* a perfect stage of the *Cercospora.* (D. G. F.) See title in Bot. Gaz., vol. 16, Sept. 15, 1891, p. 261.

613. COOKE, M. C. **Cordyceps Hawkesii, Gray.** Grevillea, vol. 19, London, Mar., 1891, pp. 76–78. Discusses the characters of the species as compared with other Australasian *Cordyceps,* and reprints the orignal description. (M. B. W.)

614. COOKE, M. C. **Memorabilia.** Grevillea, vol. 19, London, Mar., 1891, pp. 80–81. Notes that *Valsaria parmularia,* Berk., specimens so-called in Roumeguères's Fungi Gallici, No. 4338, is not that species, but probably *Valsaria rubricosa,* Fr.; *Epichloe hypoxylon,* Peck, is identical with *Hypocrella atramentosa,* B. & C.; *Agaricus* (*Galera*) *mucidolens,* Berk., belongs to *Hyporrhodii.* (M. B. W.)

615. COOKE, M. C. **New British fungi.** Grevillea, vol. 19, No. 91, London, Mar., 1891, p. 86. Describes *Hypocrea* (*Bromella*) *leptogicola,* Cke. & Mass., on *Leptogonium* growing upon *Robinia; Stuartella Carlylei* Cke. & Mass., *Mollisia dactyligluma,* on *Dactylis glomerata,* and *Lachnella stigmella.* (M. B. W.)

616. DELACROIX, G. **Espèces nouvelles de champignons inférieurs.** Bull. Soc. Mycol. France, vol. 7, Paris, June 30, 1891, pp. 104–111, pl. 2. Describes *Plowrightia Karsteni, Herpotrichia ceralium, Ceratostoma truncatum, C. stromaticum, Nectriella maydis, Zignœlla culmicola,* Delacr. & Niel, *Chætomella longiseta, C. tortilis, Macrophoma carpincola, Coryneum faginum, Penicillium Duclauxi, Moronopsis* (nov. gen) *inquinans, Sterigmatocystis ochracea, Dictyosporium secalinum, Fusarium æruginosum, Fusicoccum populinum, F. complanatum.* (E. A. S.)

617. MACMILLAN, CONWAY. **Notes on fungi affecting leaves of Sarracenia purpurea in Minnesota.** Bull. Torrey Bot. Club, vol. 18, July, 1891, pp. 214–215. Gives notes on *Sphærella sarraceniæ* (Schw.) Sacc., *Leptosphæria scapophila* (Peck), Sacc., *Peziza abrata* and *Pestalozzia aquatica,* E. & E. Describes as new species *Helminthosporium sarraceniæ* and *Brachysporium sarraceniæ.* (D. G. F.)

618. PRILLIEUX ET DELACROIX. **Complément a l'étude de la maladie du cœur de la betterave.** Bull. Soc. Mycol., France, vol. 7, Paris, Mar. 21, 1891, pp. 23–25,

fig. 9. *Sphærella tabifica*, a new species found in connection with *Phyllosticta tabifica* is considered as the ascomycetous form of the latter. Describes this together with the following new species found in connection with the *Phyllosticta*: *Ascochyta betæ*, *A. beticola*, *Diplodia beticola*. (E. A. S.)

619. WESTWOOD, I. O. **Parasites on Plants and Animals.** Gard. Chron., 3d ser., vol. 9, London, May, 1891, p. 553, 2 cols., fig. 4. Popular description of the external appearance of *Cordyceps* on larvæ. (M. B. W.)

(See also Nos. 392, 445, and 621.

IV.—*Discomycetes.*

620. BOYER. **Note sur la Reproduction des Morilles.** Bull. Soc. Mycol., France, vol. 7, No. 3, Paris, Sept. 30, 1891, p. 150. Gives details of a successful experiment in reproducing the Morel on a substratum apparently free from infection before sowing on it the débris of some partially liquefied specimens. (E. A. S.)

621. COOKE, M. C. **Omitted Diagnoses.** Grevillea, vol. 19, London, March, 1891, pp. 71–75. Contains descriptions of 23 species of fungi which are not found in Saccardo's Sylloge, in the genera *Pesiza*, *Sphæria*, *Helotium*, *Phialia*, *Lachnella*, *Bulgaria*, *Ombrophila*, *Ryparobius*, *Patellaris*, *Phacidium*, and *Phoma*. (M. B. W.)

622. PHILLIPS, W. **Omitted Discomycetes.** Grevillea, vol. 19, No. 92, London, June, 1891, pp. 106–107. Contains descriptions of the following species not in Saccardo's Sylloge. *Aumaria stomella* Cke. and Phil., n. sp., *Hymenoscypha Carmichælii*, Berk., Phil., *H. flexipes*, Cke. and Phil., *Helotium aurantiacum*, Cke., *Mollisia chlorosticta*, E. P. Fries, *Lachnella luzulina*, Phil. = *Dasyscypha hyalina* (Phill.) Sacc., *L. albopileata*, Cke. var. *subaurata*, Ellis; *L. conformis*, Cke., *Encœlia hypochlora* Berk. and Curt. (M. B. W.)

(See also Nos. 445, 452, 615, and 644.)

I.—IMPERFECT AND UNCLASSIFIED FORMS.

I.—*Hyphomycetes and Stilbeæ.*

623. BOUDIER, EM. **Quelques nouvelles espèces de Champignons inférieurs.** Bull. Soc. Mycol., France, vol. 7, No. 7, Paris, June 30, 1891, pp. 81–83, pl. 1. Describes the following new species: *Botrytis albido-cæsia*, *Mycogone ochracea*, *Volutella albopila*, *Hymenula citrina*. (E. A. S.)

624. DUFOUR, JEAN. **Le Champignon parasite des vers blancs.** Chron. Agric. Vit. et Fores. du Vaud, vol. 4, Lausanne, Nov. 10, 1891, pp. 376–384. Gives some general notes on the presence of entomogenous fungi. Describes the ravages of *Botrytis tenella* on the white worm, and mentions the consequent attempts to propagate the fungus by infecting worms with spores produced in artificial cultures. In order to test this, several experiments were tried. Healthy worms were infected, both confined in pots and in the open ground. The worms seemed to resist the parasite even in the closed pots, and more strongly in the open ground. The conditions favoring a rapid infection are not yet known. (E. A. S.)

625. GIARD, ALFRED. **Nouvelle recherches sur le Champignon parasite du hanneton vulgaire (Isaria densa, Link).** Comptes Rend., Soc. Biol., new ser., vol. 3, Paris, July 23, 1891, pp. 575–579. Shows that the fungus of the white worm was common in Lower Seine in 1866. Since then the equilibrium between the insect and its parasite has been preserved. The balance could, however, be turned in favor of the latter by spreading liquid cultures of the spores over the infested territory. The article contains the same notes on synonomy as No. 624. (E. A. S.)

626. GIRARD, ALFRED. **Sur la transmission de l'Isaria du ver blanc au ver à Soie (Isaria densa, Link).** Comptes Rend., Soc. Biol., new ser., vol. 3, Paris, July 2, 1891, pp. 507–508. Shows that it is possible to infect the silk worm with the *Isaria* of the white worm. Hopes in this way to discover whether the *Isaria* is modified by its change of hosts and whether it approaches *Botrytis Bassiana*. Suggests that care should be used in spreading the *Isaria* over regions where the silk worm is raised. (E. A. S.)

627 MAYO, N. S. **Enzootic cerebritis, or "staggers" of horses.** Bull. Kansas State Agric. Ex. Sta., Vet. Dept., No. 24, Manhattan, Sept., 1891, pp. 107–116, pl. 1. Reports results of experiments with moldy corn as the supposed cause of the "blind" or "mad staggers." Thinks the spores of *Aspergillus glaucus* are capable, when introduced into the circulation of the animal, of producing the disease. The presence of the growing mycelia thought to be ascertained in the liver of guinea pig inoculated with water containing spores of the fungus. Gives result of experiment with colt fed upon corn covered with *Aspergillus glaucus*, attributing final death of the animal to presence of the spores of the fungus in its system. (See also Rept. Kansas State Board Agric., Topeka, Sept., 1891, pp. 42–50; noticed in Exper. Sta. Rec., vol. 3, January, 1892, pp. 388–389.) (D. G. F.)

628. PRILLIEUX ET DELACROIX. **Endoconidium temulentum, nov. gen. nov. sp., Prill. et Dela., Champignon donnant au seigle des propriétés vénéneuses.** Bull. Soc. Mycol., France, vol. 7, No. 2 June 30, 1891, pp. 116–117, fig. 2. Describes the new genus, *Endoconidium*, having the spores formed within a tube. Species *E. temulentum*, found on rye in 1890, in the department of Dordogne, and giving it a poisonous quality. On a few of the same grains was found another new species, *Fusarium miniatum*, related to *F. ruberrimi*, Dela. (E. A. S.)

629. SKUSE, F. A. A. **The New Zealand vegetable caterpillar.** Victorian Naturalist, vol. 8, Melbourne, June–July, 1891, pp. 47–48. Refers to paper by Thos. Steel, and states that the larva attacked by the fungus *Isaria Robertsii* is not that of *Hapialus virescens*. Quotes from other authorities in reference to this point, and it therefore remains a question as to the species attacked by the fungus. (J. F. J.)

630 THAXTER, ROLAND. **On certain New or Peculiar North American Hyphomycetes, II.** Bot. Gazette, vol. 16, July, 1891, pp. 201–205, pl. 2. Describes *Helicocephalum sarcophilum*, nov. gen. et nov. sp., on carrion from Conn., found in laboratory cultures; *Gonatorrhodiella parasitica*, nov. gen. et nov. sp., on *Hypocrea* and *Hypomyces; Desmidiospora myrmecophila*, nov. gen. et nov. sp., on the body of a large ant, Conn. Remarks this latter species may possibly be an imperfect form of *Cordyceps unilateralis*, Tul., and suggests possibility of its being parasitic on young *Isaria* or *Cordyceps* previously developed on the insect. Describes also *Everhartia lignatilis*, nov. sp., on wet logs from Conn., figuring *E. hymenuloides* Sacc. and Ellis for comparison. (D. G. F.)

631. TRABUT, L. **Les Champignons parasites du Criquet Pèlerin.** Rev. Gen. Bot., vol. 3, No. 34, Paris, Oct. 15, 1891, pp. 401–405, pl. 1. Notes a fungous disease on the migratory locust (*Acridium perigrinum*) in Algeria, found especially on females after laying the eggs. The fungus was named *Botrytis acridiorum* by the author, and *Lachnidium acridiorum* by Giard, the latter name being adopted in the article. MM. Knuckel and Langlois have referred it to *Polyrhigium leptophyci*, Giard. The fungus develops on all the membranes covering the joints, but more especially between the abdominal rings. It is entirely superficial never penetrating the body cavities. Two kinds of spores have been found—one round and unicellular, the other elongated and septate. The article also describes *Cladosporium herbarum*, var. and *Saccharomyces? parasitaris* as parasitic on the bodies, and *Oospora ovorum*, n. sp. on the eggs of the insects. (E. A. S.)

(See also Nos. 445, 541, 612, 616, and 617.)

II.—*Sphæropsideæ and Melanconeæ.*

632. PAMMEL, L. H. **Spot Disease of Cherry (Cylindrosporium padi.)** Bull. Iowa Agric. Ex. Sta. [Ames], No. 13, Des Moines, May, 1891, pp. 55–66, pl. 2, fig. 3. Discusses synonomy of the species and describes the microscopic characters of the fungus with list of plants affected by it. (D. G. F.)

633. PAMMEL, L. H. **Spot Disease of Currants and Gooseberries.** Bull. Iowa Agric. Ex. Sta. [Ames], No. 13, Des Moines, May, 1891, pp. 67–71, figs. 3. Discusses the literature and geographical distribution of *Septoria ribis*, Desm., *Cercospora angulata*, Wint. and *Glœosporium ribis*, Peck. Expresses the opinion that the *Cercospora* is the fungus which causes in part the defoliation of white and red currants. Thinks *Sphærella grossulariæ*, Fr. is genetically connected with *Cercospora angulata*, Wint., and also with *Septoria ribis*, Desm. (D. G. F.)

634. PRILLIEUX ET DELACROIX. **Hendersonia cerasella, nov. sp.** Bull. Soc. Mycol., France, vol. 7, No. 1, Paris, Mar. 31, 1891, pp. 21–22, figs. 2. Describes *Hendersonia cerasella*, a new species found on the sterile spots of *Coryneum Beijerinckii* on cherry leaves. (E. A. S.)

(See also Nos. 383, 391, 445, 616, 617, 618, and 621.)

III.—*Miscellaneous.*

635. COMSTOCK, J. H., and SLINGERLAND, M. V. **Wireworms.** Bull. Cornell Univ. Agric. Ex. Sta., entomological division, No. 33, Ithaca, Nov., 1891, p. 211. Notes *Metarrhisium anisopliæ*, as determined by Thaxter, attacking and killing the larvæ of wireworms under experiment. (D. G. F.)

636. MASSEE, GEO. **Sarcomyces, new genus.** Grevillea, vol. 20, London, 1891, pp. 13–14. Describes *Sarcomyces vinosa* nov. gen. and nov. sp., on wood from Venezuela and South Carolina. (D. G. F.)

637. SOUTHWORTH, EFFIE A. **Notes on some curious fungi.** Bull. Torrey Bot. Club, vol. 18, Oct., 1891, pp. 303–304. Describes briefly peculiar fungus, possibly *Polyporus officinalis* from California, and *Erysiphe* like form on *Muhlenbergia*: also a superficial fungus on bark of orange likely to prove a species of *Phymatomosphaeria*. (D. G. F.)

(See also Nos. 437, 445, and 631.)

G.—MORPHOLOGY AND CLASSIFICATION OF BACTERIA.

638. BLANCHARD, DR. R. **Sur un Spirille géant développé dans les cultures de sédiments d'eau douce d'Aden.** Rev. gén. sci., pure et appliq., 2 ann. Paris, Jan. 15, 1891. pp. 21–22, figs 8. Review of a paper by A. Certes in Bull. de la Soc. Zool. de France, t. 14, p. 322. (E. F. S.)

639. HENNEGUY, F. **Contribution à l'étude de la morphologie et du développement des Bactériacéaes.** Rev. gén. sci., pure et appliq., 2 ann. Paris, Jan. 15, 1891. p. 21. Review of a paper by A. Billet in Bull. Scientifique du Nord de la France et de la Belgique, t. 21, 1890. (E. F. S.)

641. MANGIN, L. **Die Pflanzen und Thiere in den dunklen Raumen der Rotterdamer Wasserleitung.** Rev. gén. sci. pure et appliq., 2 ann., Paris, Mar. 30, 1891, p. 193–194. Review (in French) of a paper by Hugo de Vries on the presence of *Crenothrix Kuhniana* in the water supply of Rotterdam. (E. F. S.)

642. METCHNIKOFF, E. **Les idées nouvelles sur la structure, le développement et la reproduction des bactéries.** Rev. gén. sci. pure et appliq., 2 ann., Paris, April 15 1891, pp. 211–216, figs. 14. The author considers bacteria most nearly related to the lower algæ. The possession of a true nucleus, which often fills nearly the entire cell; the occurrence of pleomorphism, now proved for pathogenic

as well as saprophytic forms; the existence of gelatinous zoögloea; the existence of cilia, even in Coccus forms, and the multiplication by fission are all bonds of kinship with Cyanophyceæ. One objection to this view is the total absence of endospores in algæ. The formation of endospores connects the bacteria with the flagellate infusoria, while in their branching they recall fungi. Botanists have laid great stress on the fact that the spores of some bacteria germinate at the poles and others at the equator. The fact is, both methods occur in the same species. (E. F. S.)

(See also Nos. 527, 543, and 588.)

H.—MORPHOLOGY AND CLASSIFICATION OF MYXOMYCETES.

643. BALLIET, LETSON. **Slime molds.** The Ornithologist and Botanist, vol. I, Binghamton, N. Y., Nov., 1891, p. 85, 1 col. Under this heading, describes popularly *Protococcus* on flowerpots. (D. G. F.)

644. BUCKNALL, CEDRIC. **The fungi of the Bristol district.** Part XIII, Proc. Bristol Nat. Soc., new ser., vol. 6, Bristol, 1891, pp. 274–277. A list of thirty fungi of various orders added to the flora of Bristol, with descriptions of some of the species. The following are described as new: *Oligonema furcatum*, *Perichæna confusa*, Masse in litt., *Lachnella fragariastri*, Phil. in litt. (M. B. W.)

645. LISTER, ARTHUR. **Notes on Mycetozoa.** Jour. of Bot., vol. 29, London, Sept., 1891, pp. 257–268, pl. 5. Contains descriptions of fourteen species not included in Cooke's Myxomycetes of Great Britain, with five plates. The following new species are described: *Physarum calidris*, *Cornuria depressa*, *Hemiarcyria intorta*. (M. B. W.)

646. NIEL, M. **Remarques à propos des Tubulina fragiformis, Pers., et cylindrica, Bull.** Bull. Soc. Mycol. France, vol. 7, No. 2, Paris, June 30, 1891, p. 98. Points out the differences between the two species as mentioned in previous descriptions. Does not see Saccardo's reasons for combining them. (E. A. S.)

647. REX, GEO. A. **Hemiarcyria clavata, Pers.** Proc. Acad. Nat. Sci. Phila., Part II. Phila., 1891, pp. 407–408. Records discovery of spinose processes on the spiral thickenings of the threads of capillitium of this species by use of oil immersion lens. (D. G. F.)

648. REX, GEO. A. **New American Myxomycetes.** Proc. Acad. Nat. Sci. Phila., Part II. Phila., 1891, pp 389–398. Describes the following species as new: *Physarum nucleatum*, *Physarum penetrale*, *Chondrioderma aculeatum*, *Stemonitis Webberi*, *Stemonitis Virginiensis*, *Stemonitis nigrescens*, *Comátricha irregularis*, *Cribraria violacea*, *Cribraria languescens*, *Trichia Andersoni*, *Hemiarcyria longifila*, *Hemiarcyria Varneyi*, *H. obscura*, *Dianema*, nov. gen., *D. Harveyi*. (D. G. F.)

649. REX, GEO. A. **Trichia proximella, Karst.** Proc. Acad. Nat. Sci. Phila., Part III, Dec. 16, 1890, pp. 436–438. Gives comparison of *Trichia proximella* Karst, and *T. Jackii* Karst, and a series published in JOURNAL of MYCOLOGY, Aug., 1886, as possessing diagnostic characters of *T. affusis*, DBy. and *T. Jackii*, Rostf. Decides all three as forms differing only in development. (D. G. F.)

650. WINGATE, HAROLD. **Note on Stemonitis maxima, Sz.** Proc. Acad. Nat. Sci. Phila., Part II. Phila., 1891, p. 438. Gives result of examination of type specimens of *Stemonitis maxima*, Sz., found in Schweinitz herbarium which he decides is identical with a form found commonly in vicinity, to be issued shortly in N. Am. Fungi. (D. G. F.)

(See also No. 652.)

J.—TECHNIQUE.

652. Cook, O. F. **Methods of collecting and preserving Myxomycetes.** Bot. Gazette, vol. 16, Sept. 15, 1891, p. 263. Notice of remarks made before the Bot. Club of A. A. A. S., Aug., 1891, describing method of preservation of specimens of *Myxomycetes* by use of two stiff pieces of cardboard, separated by strips of cork glued to each end, between which the specimens are glued. The two pieces of cardboard are then inclosed in an ordinary herbarium pocket. (D. G. F.)

653. Graziani, A. **Les réactifs utilisés pour l'étude microscopique des champignons.** Bull. Soc. Mycol. France, vol. 7, Paris, Sept. 30, 1891, pp. 189–192. A list of reagents used in studying fungi, together with formulæ for those that are not simple liquids or solutions. (E. A. S.)

(See also Nos. 545, and 647.)

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF VEGETABLE PATHOLOGY.

Vol. VII. No. 3.

THE JOURNAL OF MYCOLOGY:

DEVOTED ESPECIALLY TO THE STUDY OF FUNGI IN THEIR RELATION TO PLANT DISEASES.

EDITED BY

THE CHIEF OF DIVISION AND HIS ASSISTANTS.

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PUBLICATIONS OF THE SECTION OF VEGETABLE PATHOLOGY.

JOURNALS.

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No. 3.* Report on the Experiments made in 1891 in the Treatment of Plant Diseases. 1892, pp. 76, pl. 8.

No. 4. Experiments with fertilizers for the prevention and cure of Peach Yellows, 1889-1892. (In press.)

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Farmers' Bulletin No. 5.* Treatment of Smuts of Oats and Wheat. 1892, pp. 8, pl. 1.

Farmers' Bulletin No. 7.* Spraying Fruits for Insect Pests and Fungous Diseases. 1892, pp. 20.

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EXPERIMENTS IN THE TREATMENT OF RUSTS AFFECTING WHEAT AND OTHER CEREALS.

By B. T. GALLOWAY.

INTRODUCTION.

No plant diseases have attracted as widespread attention as the rusts of cereals. For more than a hundred years scientists and practical men all over the world have made these parasites the subject of study and thought, but as yet nothing definite is known as regards a practical and efficient means of preventing them. At the present time the rust of wheat is probably attracting more attention in Australia than any other country. The whole colony is alarmed at the ravages of the rust pest, which, it is estimated, causes a loss of over $10,000,000 annually. At a recent rust conference held in Sydney,* delegates were present from Victoria, South Australia, Queensland, and New South Wales. Some knowledge of what was done at this gathering may be gained when it is stated that it lasted five days and that the report of its proceedings embodies over fifty thousand words. The delegates were a representative body of men, and the report shows them to be thoroughly conversant with nearly all known facts bearing upon this important subject. In this country rust has of late attracted no great amount of attention. This is not due to a diminution in the amount of damage it occasions, but is owing to the fact that the annual drain upon the farmers' income, which it causes, has come to be regarded as a matter of course. Year after year the crop in nearly every field is cut short by rust, so that it is difficult to say just how much damage results simply because there are no figures for comparison.

The average yield of wheat in the United States in 1891 was only 15.3 bushels per acre,† an amount insignificant when compared with some countries that do not have half the natural advantages. This abnormally low yield is, of course, due to several causes, rust being

* A review of the report of this conference is to be found on another page of this JOURNAL.

† Report U. S. Department of Agr., 1891, p. 29.

one of them. By better methods of farming, such as the improvement of varieties, crop rotation, the prevention of rust and smut, proper use of plant foods, etc., the average yield could in all probability be raised to 20 bushels per acre at comparatively little additional expense. Such an increase would mean to our farmers more than $170,000,000, annually. The rust problem, so far as it concerns the yield of grain, probably exerts as great an influence as any one thing over which there is a possibility of control. It is important, therefore, that all phases of the subject be fully investigated as it is by this means only that proper conclusions in regard to prevention can be reached.

PLAN OF THE WORK.

In planning the work on rust it seemed desirable at first to limit the investigations to two lines of research. These may be briefly summarized as follows:

(1) Experiments in spraying with various chemicals and in treating the soil and seed in various ways in the hope of preventing the disease.

(2) Comparative studies of several so-called rust-resisting and nonrust-resisting varieties, to determine whether they possess more or less constant anatomical or physiological characteristics which may explain susceptibility or nonsusceptibility to the disease.

This paper, as the title indicates, will deal with the first problem, *i. e.*, experiments in spraying and in soil and seed treatments to determine their effects on rust. At the outset it was decided to make an attempt to prevent rust without any special regard to expense, it being thought that the latter question could be considered later as a distinct problem. It is proper here to acknowledge the valuable assistance rendered by W. T. Swingle, P. H. Dorsett, and D. G. Fairchild. The experiments would doubtless have been largely under the supervision of Mr. Swingle but for the fact that more immediately important labors called him elsewhere. With but one exception all the treatments at Garrett Park, Md., were made by Mr. Dorsett. He also collected the specimens at each treatment, made the many necessary tedious counts of plants, and harvested and threshed the grain. Mr. Fairchild aided materially in making out the formulæ for fungicides and also assisted in other lines of work.

In order that the work might be carried on under as widely different conditions of soil and climate as possible, Maryland and Kansas were selected as the States in which to make the experiments. In Maryland the work was carried on under the supervision of the writer, while in Kansas a part was intrusted to J. F. Swingle, of Manhattan, and a part to E. Bartholomew, of Rockport, 160 miles northwest of the former place. The experiments at the three stations were in most respects similar, but for the sake of convenience they will be described under separate heads.

Before taking up the experiments in detail, it may be said that they were designed primarily to determine—

(1) The effect on winter wheat of treating the soil with various chemicals before planting.

(2) The effect of treating the seed, previous to planting, with chemicals and with hot water.

(3) The effect of spraying and dusting the plants every ten days from the time they appeared above ground until harvest, using various preparations having known fungicidal value and others that had never been tested in this respect.

(4) The effect of spraying and dusting every twenty days, beginning and ending the same as in (3), and also using the same preparations.

(5) The effect of spraying and dusting the plants every ten days, combined with soil treatment alone and with both soil and seed treatments.

(6) The effect of spraying and dusting every twenty days combined with the other treatments, as in (5).

(7) The effect on spring-planted wheat, oats, and rye of spraying and dusting with various fungicides and other preparations at intervals of two, ten, and twenty days, respectively.

From the foregoing it will be seen that there were soil and seed treatments; spraying and dusting at intervals of two, ten, and twenty days; and a combination of these various methods. In all cases it should be borne in mind that the word "effect" is here used in a broad sense, that is, it includes the influence of the various treatments on rust, as well as on the soil, seed, and plants. The foregoing general summary of the objects of the work will, it is hoped, enable the reader to understand the details which will now be taken up.

EXPERIMENTS AT GARRETT PARK, MARYLAND.

For the work at this place a piece of ground 400 feet long and 110 feet wide was selected. It was comparatively level, and as regards fertility and other necessary important conditions, was fairly even throughout.

On September 20, 1891, the ground was plowed and thoroughly harrowed, but owing to the fact that for several years it had been in clover it was with difficulty put in good condition for planting. On October 5 it was platted, the plats throughout being 3 feet wide and 33 feet long. Walks 2 feet wide were left between each plat, and alleys 3 feet wide were run every 33 feet from end to end of the entire block. Planting began on October 14 and was finished on the 25th of the same month. Every plat was planted by hand, the grain being sown at the rate of 2 bushels per acre in drills 9 inches apart. The drills were opened with a hoe, and after sowing the grain was covered with the same implement. The following is a list of the various treatments, set forth in tabular form.

TABLE 1.—*Statement of the method of treating each plat in the wheat-rust experiment at Garrett Park, Md.*

SERIES I.—SOIL TREATMENT.

Plats.	Kind of treatment.
1 and 91	Untreated.
2 and 92	Soil treated with flowers of sulphur, 4 ounces to each 20 feet of row.
3 and 93	Untreated.
4 and 94	Soil treatment with flowers of sulphur, 2 ounces to each 20 feet of row.
5 and 95	Untreated.
6 and 96	Soil treatment with flowers of sulphur, 1 ounce to each 20 feet of row.
7 and 97	Untreated.
8 and 98	Soil treatment with flowers of sulphur and air-slaked lime, equal parts mixed, 4 ounces to each 20 feet of row.
9 and 99	Untreated.
10 and 100	Soil treatment with flowers of sulphur and air-slaked lime, equal parts mixed, 2 ounces to each 20 feet of row.
11 and 101	Untreated.
12 and 102	Soil treatment with powdered ferrous sulphate, exsiccated, 4 ounces to each 20 feet of row.
13 and 103	Untreated.
14 and 104	Soil treatment with solution of ferrous sulphate, 8 ounces to 1 gallon of water, sprayed on the ground at the rate of ½ gallon to each 20 feet of row.
15 and 105	Untreated.
16 and 106	Soil treatment with ½ gallon of Bordeaux mixture to each 20 feet of row.
17 and 107	Untreated.
18 and 108	Soil treatment with ½ gallon of water containing ½ ounce of potassium sulphide (liver of sulphur) to each 20 feet of row.
19 and 109	Untreated.
20 and 110	Soil treatment with ½ gallon of ammoniacal solution of copper carbonate to each 20 feet of row.
21 and 111	Untreated.
22 and 112	Soil treatment with ½ gallon of Bordeaux mixture to each 20 feet of row.
23 and 113	Untreated.
24 and 114	Soil treatment with a solution of potassium bichromate 1½ ounces in 13½ quarts of water, sprayed on the entire plat.
25 and 115	Untreated.

SERIES II.—SEED TREATED BY IMMERSION.

26 and 116	Seed treatment, immersed for 15 minutes in water at a temperature of 132½° F.
27 and 117	Untreated.
28 and 118	Seed treatment, immersed for 24 hours in an 8:100 solution of copper sulphate, then limed.
29 and 119	Untreated.
30 and 120	Seed treatment, immersed for 24 hours in Bordeaux mixture.
31 and 121	Untreated.
32 and 122	Seed treatment, immersed for 24 hours in potassium bichromate, 5:100 solution.
33 and 123	Untreated.
34 and 124	Seed treatment, immersed for 24 hours in a solution of potassium sulphide (liver of sulphur), 1 ounce to 1 gallon of water.
35 and 125	Untreated.
36 and 126	Seed treatment, immersed for 24 hours in a solution of potassium sulphide (liver of sulphur), ½ ounce to 1 gallon of water.
37 and 127	Untreated.
38 and 128	Seed treatment, immersed for 24 hours in a 1:1000 solution of corrosive sublimate.
39 and 129	Untreated.

SERIES III.—PLANTS SPRAYED AND DUSTED.

40 and 130	Plants sprayed every 10 days, from the time they appeared above ground, with Bordeaux mixture.
41 and 131	Untreated.
42 and 132	Plants sprayed every 10 days, from the time they appeared above ground, with ammoniacal solution of copper carbonate.
43 and 133	Untreated.
44 and 134	Plants sprayed every 10 days, from the time they appeared above ground, with a solution of potassium sulphide, 2 ounces to 3 gallons of water.
45 and 135	Untreated.
46 and 136	Plants sprayed with Bordeaux mixture every 20 days.
47 and 137	Untreated.

LE 1.—*Statement of the method of treating each plat in the wheat-rust experiments at Garrett Park, Md.*—Continued.

SERIES III.—PLANTS SPRAYED AND DUSTED—Continued.

Plats.	Kind of treatment.
48 and 138	Plants sprayed every 20 days with ammoniacal solution of copper carbonate.
49 and 139	Untreated.
50 and 140	Plants sprayed every 10 days with cupric ferrocyanide mixture.
51 and 141	Untreated.
52 and 142	Plants sprayed every 10 days with ferrous ferrocyanide mixture.
53 and 143	Untreated.
54 and 144	Plants sprayed every 10 days with copper borate mixture.
55 and 145	Untreated.
56 and 146	Plants sprayed every 10 days with ferric chloride solution.
57 and 147	Untreated.
58 and 148	Plants dusted every 10 days with flowers of sulphur.
59 and 149	Untreated.
60 and 150	Plants dusted every 10 days with sulphosteatite.

SERIES IV.—MISCELLANEOUS TREATMENTS.

61 and 151	Untreated.
62 and 152	Complete treatment with Bordeaux mixture; seed immersed 24 hours; plat sprayed before planting with 13½ quarts and plants sprayed every 10 days.
63 and 153	Untreated.
64 and 154	Complete treatment with potassium sulphide solution, 2 ounces to 2 gallons of water; grounds sprayed and plants sprayed every 10 days.
65 and 155	Untreated.
66 and 156	Seed immersed for 15 minutes in water at 132½° F.; ground sprayed with ammoniacal solution and plants sprayed every 10 days with the same preparation.
67 and 157	Untreated.
68 and 158	Seed immersed for 15 minutes in water at 132½° F.; soil treated with Bordeaux mixture and plants sprayed every 10 days with the same preparation.
69 and 159	Untreated.
70 and 160	Seed immersed for 15 minutes in water at 132½° F.; soil treated with lime and sulphur, equal parts mixed, at the rate of 4 ounces to 20 feet of row.
71 and 161	Untreated.
72 and 162	Seed immersed for 15 minutes in water at 132½° F.; soil treated with ferrous sulphate at the rate of 2 ounces to 20 feet of row.
73 and 163	Untreated.
74 and 164	Seed, soil, and plants treated with ferrous sulphate; seed immersed 24 hours in a 10 : 100 solution; soil sprayed before sowing and plants sprayed every 10 days with 4 ounces to 1 gallon of water.
75 and 165	Untreated.
76 and 166	Seed immersed in ammoniacal solution 24 hours; plants sprayed every 10 days with the same preparation.
77 and 167	Untreated.
78 and 168	Soil treated with common salt at the rate of $\frac{1}{10}$ ounce to 10 feet of row.
79 and 169	Untreated.
80 and 170	Soil treated with salt at the rate of $\frac{1}{20}$ ounce to 20 feet of row.
81 and 171	Untreated.
82 and 172	Soil treated with copper sulphate solution, 13½ ounces to 13½ quarts of water per plat.
83 and 173	Untreated.
84 and 174	Plants sprayed with cupric hydroxide mixture every 10 days.
85 and 175	Untreated.

HE FUNGICIDES AND OTHER PREPARATIONS USED IN SPRAYING AND DUSTING THE PLANTS.

Nine solutions and two powders were used in the spraying and dust ing experiments. They were as follows:

(1) Bordeaux mixture.

(2) Ammoniacal solution of copper carbonate.

(3) Ferrous ferrocyanide mixture.

(4) Copper borate mixture.

(5) Ferric chloride solution.

(6) Ferrous sulphate solution.
(7) Cupric ferrocyanide mixture.
(8) Cupric hydroxide mixture.
(9) Potassium sulphide solution.
(10) Flowers of sulphur.
(11) Sulphosteatite powder.

Numbers 1, 2, 5, 6, 9, 10, and 11 were all preparations of more or less known fungicidal value. Numbers 3, 4, 7, and 8, prepared as below described, had, so far as known, never been used in combating parasitic fungi affecting plants.* Below are set forth the formulæ of the various solutions and powders, the amount given in every case being that used per plat at each treatment:

(1) *Bordeaux mixture.*

Cupric sulphate	5.22 grams	0.184 ounce.
Lime (stone)	1.26 grams.	0.044 ounce.
Water	7,572 grams	2 gallons.

The cupric sulphate was dissolved in about a pint of water; the lime was then slaked in a separate vessel, enough water being added afterwards to make a thick whitewash. This was poured into the cupric sulphate solution and enough water added to make 2 gallons. Usually an excess of the lime milk was made up and just enough added to the copper solution to precipitate all of the cupric hydroxide. The presence of copper sulphate in solution, which always indicates an imperfect preparation, was determined by means of a 5 per cent solution of potassium ferrocyanide. A few drops of this solution, when added to the Bordeaux mixture gives a brownish red precipitate if copper sulphate in solution be present. If the reaction has been perfect no change whatever occurs.

(2) *Ammoniacal solution of copper carbonate.*

Copper carbonate	2.34 grams	0.082 ounce.
Aqua ammonia (26°)	50 cc.	1.68 ounces.
Water	7,572 grams	2 gallons.

The copper carbonate was first mixed in sufficient water to form a thick paste; the ammonia was then added and the resulting liquid was diluted with 2 gallons of water.

(3) *Ferrous ferrocyanide mixture.*

Ferrous sulphate (exsiccatus)	3.44 grams	0.192 ounce.
Potassium ferrocyanide (yellow prussiate of potash).	9 grams	0.518 ounce.
Water	7,572 grams	2 gallons.

*Lodeman, in Bull. No. 35, N. Y. Cornell Ag. Ex. Sta., used copper borate, but only as a commercial article, suspended in water.

The ferrous sulphate and potassium ferrocyanide were dissolved separately, a pint to a pint and a half of water being used in each case. When the two chemicals were completely dissolved they were poured together and enough water added to make 2 gallons. Prepared in this way the solution is of a blue black color.

(4) *Copper borate mixture.*

Cupric sulphate	5.22 grams	0.184 ounce.
Borax (sodium borate)	13.00 grams	0.458 ounce.
Water	7,572 grams	2 gallons.

This solution was prepared in exactly the same way as the last. It was pale blue in color and could scarcely be seen when applied to the leaves of plants.

(5) *Ferric chloride solution.*

Ferric chloride	0.24 gram	0.254 ounce.
Water	7,572 grams	2 gallons.

The ferric chloride was simply mixed with water, the resulting solution being of a deep orange color.

(6) *Ferrous sulphate solution.*

Ferrous sulphate (exsiccatus)	30.42 grams	1.073 ounces.
Water	7,572 grams	2 gallons.

A simple solution made by dissolving the ferrous sulphate in water.

(7) *Cupric ferrocyanide mixture.*

Cupric sulphate	5.22 grams	0.184 ounce.
Potassium ferrocyanide	11.90 grams	0.4197 ounce.
Water	7,572 grams	2 gallons.

The cupric sulphate and potassium ferrocyanide were dissolved separately, each in about a pint and a half of water. When poured together a thick paste-like, chocolate-brown precipitate is formed. This, when diluted with water gives a walnut-brown mixture.

(8) *Cupric hydroxide mixture.*

Cupric sulphate	5.22 grams	0.184 ounce.
Potassium hydrate	2.34 grams	0.082 ounce.
Water	7,572 grams	2 gallons.

This was prepared similarly to Bordeaux mixture, which it resembles somewhat in color and chemical composition.

(9) *Potassium sulphide solution.*

Potassium sulphide (liver of sulphur)	28.34 grams	0.999 ounce.
Water	7,572 grams	2 gallons.

The potassium sulphide was dissolved in the water and sprayed on the plants at once to avoid the chemical change which quickly takes place when the solution is allowed to stand exposed to the air.

(10) *Flowers of sulphur.*

The commercial article was used in the dry form.

(11) *Sulphosteatite.*

This preparation was furnished by C. H. Joosten, of New York. It is a fine greenish powder, consisting of 9 parts of steatite or talc and one part of finely-powdered copper sulphate.

The ammoniacal solution of copper carbonate, containing 2 ounces of copper carbonate dissolved in 1 quart of ammonia and diluted with 22 gallons of water was used as a basis in preparing numbers 1, 2, 4, 7, and 8 of the foregoing. Numbers 3, 5, and 6, containing iron, were double the strength of the copper preparations. As near as possible, therefore, plats treated with preparations 1, 2, 4, 7, and 8 received 1.32 grams of copper at each treatment, while plats treated with 3, 5, and 6 received 2.64 grams of iron. It will be seen that in comparison with the well-known fungicides all the preparations were very weak, the Bordeaux mixture being less than one-fortieth the standard strength.

A preliminary test was made of all the foregoing preparations, with the exception of numbers 10 and 11, to determine (1) their adhesiveness and (2) their power to wet the foliage. By adhesiveness is meant the resistance to removal by rain or dew. Power to wet the foliage really means an even distribution over the entire surface of the leaf. It was found after nearly a month's work on oats, rye, wheat, and barley that no matter in what manner the solutions were applied, with the possible exception of rubbing them on with the hand, none would spread out in a thin film over the leaf surface. When applied with an ordinary improved Vermorel nozzle the liquids would simply strike the leaf and roll off in drops. By using a large atomizer, thereby increasing the fineness of the spray, it was found possible to wet the leaves still more, but the result was far from satisfactory. Various substances, such as glue, gum arabic, molasses, honey, and milk were added to the preparations in the hope that they would increase their wetting properties. Milk was found to be fairly satisfactory, but was discarded on account of expense. None of the other substances proved of value. Finally soap, which at the time we were not aware had before been used, was tried and was found to give better results than anything hitherto employed. After testing various brands, the Ivory soap was selected as the best suited to our wants. It was accordingly used throughout the experiment, combined with all the preparations except ferrous sulphate and ferric chloride solutions; these refused to unite with the soap, and consequently they were applied without it. After a number of trials the following method of using the soap was adopted:

Seven 5-cent bars of Ivory soap were shaved up by means of a small

plane. The shavings were placed in a tin watering can and about 1 gallon of water added. The can was then placed on a small oil stove and slowly heated until the soap was dissolved. When completely dissolved, 1 quart of the liquid, or about one-fourth of the contents of the can, was added to each solution. A complete mixture was affected by pumping the liquid back into itself, using a small hand pump for the purpose. In every case the soap readily mixed with the solutions, forming a frothy, slimy fluid which dispersed itself over the leaf in a fairly satisfactory manner. It may be well at this point to explain why it is so difficult to wet the foliage of wheat, oats, and allied plants. A microscopic examination of the leaves, sheaths, and culms in many cases reveals the fact that they are covered with an exceedingly thin layer of granular wax, which not only prevents the entrance of water to the tissues from without, but also probably acts as a check to transpiration. The wax undoubtedly protects the plants in other ways, but of these and similar questions bearing on the same subject it is unnecessary to speak here.

METHODS OF APPLYING THE LIQUIDS AND POWDERS.

The liquids were all applied with a small double-acting force pump which has been used by the Division for several years in spraying experiments. The pump was provided with a Vermorel nozzle attached to a lance 2½ feet long. The lance in turn was attached to the pump by means of a piece of ¼-inch cloth insertion hose 4 feet long. The solutions were prepared in a 3-gallon bucket and sprayed from it directly upon the plants. With this apparatus a plat, even after the wheat was nearly grown, could be thoroughly sprayed in three minutes. The powders were applied part of the time by hand and part of the time with a small hand bellows. In the soil treatments the fungicide was sprayed or dusted into the bottom of the drills and the seed planted directly upon it.

Having now considered the questions of a general nature connected with the work, the detailed observations made at the time of the various treatments may be taken up.

DETAILED OBSERVATIONS ON THE TREATMENTS.

First treatment (*November 14, 1891*).—The plants at this time were from 2 to 4 inches high and showed no signs of rust or any other disease. In some of the soil and seed treatments the grain had not sprouted. It was decided, however, to make no observations on any of these plats until it was plainly apparent that the seed was killed. A careful examination of all the plats sprayed and dusted revealed the fact that potassium sulphide was the only preparation that had injured the foliage. The tips of the leaves sprayed with this chemical were, in nearly every case, whitened and shriveled. As regards the wetting power of the various preparations it may be stated that the ferrous

ferrocyanide mixture was the only one that gave anything like satisfactory results. It formed a thin film, which covered both sides of the leaves fairly well. The tendency of all the preparations, with the exception of the foregoing, was to collect in drops, and if these attained sufficient size their own weight would cause them to roll from the leaf. The inability to wet the foliage was markedly present in the case of the plats treated with Bordeaux mixture. Ammoniacal solution was somewhat better in this respect, but not so good as the copper borate and cupric ferrocyanide mixtures. Ferric chloride solution did not show on the leaves at all, nor was it possible, except in rare instances, to distinguish the ferrous sulphate on the foliage. Sulphur and sulphosteatite showed plainly at first, but a breath of wind or a little rain or dew was sufficient to remove all traces.

Second treatment (*November 25, 1891*).—No marked change had taken place in the growth of the plants since the last treatment. Some were beginning to stool and others were just pushing through the soil, showing that the seed was somewhat irregular in germinating. Not a pustule of rust could be found in the experimental block or in any of the fields near by. As regards the wetting properties of the various preparations, little change from what was noted under the first treatment was apparent. All of the liquids were slightly better in this respect, but this was no doubt due to the accumulation from the last spraying. Not a vestige of the first application of sulphur and sulphosteatite could be seen.

Third treatment (*December 5, 1891*).—At this time all the plats were examined, and in addition to collecting specimens from each, careful notes were made on the injuries, if any, resulting from the various treatments, the adhesiveness of the preparations, and the power each had of wetting the foliage. It was found that in plats 24 and 38, as well as their duplicates, not a grain had started. The first of these received a soil treatment of 13½ ounces of potassium bichromate solution to the plat; the second was a seed treatment, and consisted of immersing the grain twenty-four hours in a 1: 1000 solution of corrosive sublimate.

Plats 26, 28, 32, 70, 72, and 82 were in very bad condition, not more than 1 per cent of the grain in any case having started. The methods of treating these plats has been given in Table 1. By referring to this it will be seen that in every case where hot water was used the grain either failed entirely to start or else made a very feeble growth. A good opportunity of testing the adhesiveness of the various preparations was offered in consequence of a rainfall of nearly an inch since the last spraying. Ferrous ferrocyanide, cupric ferrocyanide, copper borate, Bordeaux mixture, ammoniacal solution, and cupric hydroxide showed on the foliage in the order named. Ferric chloride and potassium sulphide solution were scarcely visible, and sulphur and sulphosteatite had entirely disappeared. The power of wetting the foliage was constant for each preparation throughout the entire experiment

Given in the order of their efficacy in this respect they are as follows: Ferrous ferrocyanide, copper borate, cupric ferrocyanide, ammoniacal solution, Bordeaux mixture, cupric hydroxide, ferric chloride, and potassium sulphide.

Fourth, fifth, and sixth treatments (December 14 and 23, 1891, and January 4, 1892).—Nothing of importance was noted in the intervals elapsing between these treatments. At the time of the fourth spraying the potassium sulphide and ferrous sulphate solutions were injuring the foliage so badly that it was decided to dilute them to one-half the original strength. One peculiar fact noted in connection with the Bordeaux-sprayed plats was the entire absence of dew from such portions of the leaves as were covered by the preparation. It was thought that this might have an important bearing on the prevention of rust, as the presence of dew is known to be necessary for the infection of the host in the case of many parasitic fungi. Further observation, however, showed that this point was of no importance so far as our work was concerned. It was only possible to make about half of the sixth treatment, as snow began falling soon after spraying commenced and in an hour the plants were completely covered.

Seventh treatment (January 29, 1892).—From January 4 until this date the ground was covered with snow, making it impossible to reach the plants with a spray. Up to this time the most careful search had failed to reveal any trace of rust. The plants had made no growth since the spraying on January 4. With the exception of plats 44, 56, 58, and 60, treated respectively with potassium sulphide solution, ferric chloride solution, sulphur, and sulphosteatite, all the preparations were showing more or less plainly on the foliage. The ferrous ferrocyanide was especially prominent, while cupric ferrocyanide, Bordeaux mixture, and ammoniacal solution followed in this respect in the order named.

Eighth, ninth, tenth, and eleventh treatments (February 9 and 19, March 4 and 14, 1892, respectively).—At the time of each of the foregoing treatments specimens were collected from each plat and careful notes were made on them. However, nothing worthy of recording was observed.

Twelfth treatment (March 25, 1892).—The weather at this time was quite spring-like and many of the plants were beginning to grow. The duplicate plats were not in as good condition as the others, probably on account of being planted later and not having had an opportunity of getting well started before winter set in. Nothing of special importance was noted at this time.

Thirteenth, fourteenth, and fifteenth treatments (April 5, 16, and 26, 1892).—From March 25 to April 5 the plants made a growth of from 3 to 4 inches. Between the 5th and 16th the weather was quite cool, in consequence of which vegetation remained almost at a standstill. As regards the adhesiveness, wetting power, and injurious effects of

the various solutions, nothing different from what had been previously observed was noted. As yet not a sign of rust had been seen on any of the plants. It was noticed that the plants sprayed with ferrous ferrocyanide, Bordeaux mixture, and ammoniacal solution of copper carbonate were much greener than any of the others. This difference in color of foliage, due to the applications of chemicals in the form of spray, is, however, not peculiar to wheat. It has frequently been seen in the case of similar work upon other crops, but no attempts have been made to explain it.

Sixteenth treatment (May 6, 1892).—On May 1 rust was found on 1 of the untreated plats, a few pustules being seen on the leaves of several stalks arising from one root. It was decided to make no further examination until May 6, the day for the regular treatment. At this time, therefore, every plat was examined and the number of plants showing rust was counted. The rust was noted as being present if only one pustule occurred on a plant. The counting entailed an enormous amount of work, but it was the only way the desired knowledge could be obtained. The plants in all of the original plats averaged at this time from 15 to 18 inches in height, and in most respects were in good condition. Below is given, in tabular form, the results of the count on May 6.

TABLE 2.—*Showing number of plants affected with rust on May 6.*

SERIES I.—SOIL TREATMENT.

Plat.		Method of treating.	No. of plants showing rust.		Total plants showing rust.
Original.	Duplicate.		Original.	Duplicate.	
1	91	Untreated	27	0	27
2	92	Flowers of sulphur, 4 ounces to 20 feet of row	50	40	90
3	93	Untreated	25	0	25
4	94	Flowers of sulphur, 2 ounces to 20 feet of row	40	0	40
5	95	Untreated	0	0	0
6	96	Flowers of sulphur, 1 ounce to 20 feet of row	26	0	26
7	97	Untreated	29	16	45
8	98	Flowers of sulphur and lime, equal parts mixed, 4 ounces to 20 feet of row	21	0	21
9	99	Untreated	0	2	2
10	100	Flowers of sulphur and lime mixed, 2 ounces to 20 feet of row	4	0	4
11	101	Untreated	18	0	18
12	102	Ferrous sulphate, 4 ounces to 20 feet of row	15	0	15
13	103	Untreated	31	0	31
14	104	Ferrous sulphate, 8 ounces to 20 feet of row	12	0	12
15	105	Untreated	56	0	56
16	106	Bordeaux mixture, ½ gallon to 20 feet of row	37	0	37
17	107	Untreated	21	0	21
18	108	Potassium sulphide, ½ ounce to ½ gallon of water to 20 feet of row	31	0	31
19	109	Untreated	93	0	93
20	110	Ammoniacal solution, ½ gallon to 20 feet of row	61	0	61
21	111	Untreated	5	0	5
22	112	Bordeaux mixture, ½ gallon to 20 feet of row	7	0	7
23	113	Untreated	1	49	50
24	114	Potassium bichromate, 1½ ounces in 1½ quarts water per plat	dead	dead	
25	115	Untreated	47	0	47

TABLE 2.—*Showing number of plants affected with rust on May 6*—Continued.

SERIES II.—SEED TREATED BY IMMERSION.

Plat. Original.	Plat. Duplicate.	Method of treating.	No. of plants showing rust. Original.	No. of plants showing rust. Duplicate.	Total plants showing rust.
26	116	Water heated to 132½° F., 15 minutes	6	0	6
27	117	Untreated	0	0	0
28	118	Copper sulphate, 24 hours in 8:100 solution	3	0	3
29	119	Untreated	1	0	1
30	120	Bordeaux mixture, 24 hours	21	0	21
31	121	Untreated	20	0	20
32	122	Potassium bichromate, 24 hours, 5:100 solution	0	0	0
33	123	Untreated	3	0	3
34	124	Potassium sulphide, 24 hours, solution containing 1 ounce of potassium sulphide to 1 gallon of water	55	0	55
35	125	Untreated	0	0	0
36	126	Potassium sulphide, 24 hours, solution containing ½ ounce to 1 gallon of water	7	0	7
37	127	Untreated	0	0	0
38	128	Corrosive sublimate, 1:1000 solution, 24 hours	0	0	0
39	129	Untreated	0	0	0

SERIES III.—PLANTS SPRAYED AND DUSTED.

40	130	Bordeaux mixture, every 10 days	0	0	0
41	131	Untreated	42	0	42
42	132	Ammoniacal solution, every 10 days	0	0	0
43	133	Untreated	58	0	58
44	134	Potassium sulphide solution, 1 ounce to 1½ gallons of water, every 10 days	1	0	1
45	135	Untreated	24	0	24
46	136	Bordeaux mixture, every 20 days	2	0	2
47	137	Untreated	0	0	0
48	138	Ammoniacal solution, every 20 days	10	0	10
49	139	Untreated	15	0	15
50	140	Cupric ferrocyanide mixture, every 10 days	8	0	8
51	141	Untreated	25	0	25
52	142	Ferrous ferrocyanide mixture, every 10 days	4	0	4
53	143	Untreated	3	0	3
54	144	Copper borate mixture, every 10 days	0	0	0
55	145	Untreated	87	0	87
56	146	Ferric chloride solution, every 10 days	0	0	0
57	147	Untreated	12	0	12
58	148	Flowers of sulphur, dusted on every 10 days	20	0	20
59	149	Untreated	1	0	1
60	150	Sulphosteatite, dusted on every 10 days	10	0	10

SERIES IV.—MISCELLANEOUS TREATMENTS.

61	151	Untreated	1	0	1
62	152	Seed immersed for 24 hours in Bordeaux mixture, ground sprayed before planting, and plants sprayed every 10 days with same preparation	0	0	0
63	153	Untreated	0	0	0
64	154	Seed immersed 24 hours in potassium sulphide solution, 1 ounce to 1 gallon of water, soil sprayed, and plants sprayed every 10 days with the same preparation	0	0	0
65	155	Untreated	8	0	8
66	156	Seed immersed in hot water 15 minutes, ground sprayed with ammoniacal solution, and plants sprayed with same preparation every 10 days	0	0	0
67	157	Untreated	8	0	8
68	158	Seed immersed in hot water 15 minutes, soil sprayed with Bordeaux mixture, and plants sprayed with same preparation every 10 days	0	0	0
69	159	Untreated	65	6	71
70	160	Seed immersed in hot water 15 minutes, soil treated with lime and sulphur, equal parts, 4 ounces to 20 feet of row	0	0	0
71	161	Untreated	83	0	83

TABLE 2.—*Showing number of plants affected with rust on May 6*—Continued.

SERIES IV.—MISCELLANEOUS TREATMENTS—Continued.

Plat.		Method of treating.	No. of plants showing rust.		Total plants showing rust.
Original.	Duplicate.		Original.	Duplicate.	
72	162	Seed immersed 15 minutes in hot water, soil treated with ferrous sulphate, 2 ounces to 20 feet of row	0	0	0
73	163	Untreated	5	0	5
74	164	Seed treated 24 hours in 10:100 solution of ferrous sulphate, soil sprayed with same preparation, plants sprayed every 10 days with 4 ounces to 1 gallon of water	0	0	0
75	165	Untreated	10	0	10
76	166	Seed immersed 24 hours in ammoniacal solution, plants sprayed every 10 days with same preparation	0	0	0
77	167	Untreated	25	0	25
78	168	Soil treated with salt, $\frac{1}{16}$ ounce to 10 feet of row	8	0	8
79	169	Untreated	20	0	20
80	170	Soil treated with salt, $\frac{1}{16}$ ounce to 20 feet of row	35	0	35
81	171	Untreated	17	0	17
82	172	Soil treated with copper sulphate solution, 13¼ ounces to 13¼ quarts of water per plat	nearly dead.		....
83	173	Untreated	0	0	0
84	174	Plants sprayed with cupric hydroxide mixture every 10 days	0	0	0
85	175	Untreated	0	0	0

In a study of the foregoing table one of the most striking things noticed is the absence of rust from nearly all the duplicate plats. It should be remembered that all of these were planted from a week to ten days later than the originals; in point of growth they were at least this much behind the latter at the time of the count. The only suggested explanation of lack of rust at this time is upon the assumption that the plants had not reached the proper age for infection. If this be true, as subsequent observations would seem to indicate, the fact has considerable practical value, as it would point to the possible existence of what may be called a susceptible period, at which time a special effort in the way of protecting the plant would be highly important. If such a period really exist the earlier treatments would be of little use and consequently might be abandoned. Looking over the soil treatments, it appears that in no case did they have any appreciable effect on the prevalence of rust. The 12 plats treated gave 304 plants affected, while the untreated showed 354 plants.

In the case of the plats where seed treatments were made, 92 plants were found affected with rust, while the 7 untreated plats used as control gave only 24 plants. The plats sprayed and dusted showed some interesting results. No rust whatever was found on No. 40, sprayed every ten days with Bordeaux mixture, nor could the slightest trace of the fungus be discovered on plat 42, sprayed with ammoniacal solution every ten days. The untreated plats adjoining Nos. 40 and 42 showed, respectively, 42 and 58 affected plants. The plats sprayed with Bordeaux mixture and ammoniacal solution every twenty days were not in as good condition as those where the ten-day treatments were employed. ~king the sprayed and dusted plats as a whole, there was no striking

lifference between them and the untreated so far as rust was concerned. Where Bordeaux mixture, ammoniacal solution, ferrous ferroyanide, and cupric ferrocyanide were used the wheat was certainly nuch greener and more vigorous than in the untreated plats. In the niscellaneons treatments nothing appears to warrant the assumption hat any of them prevented rust.

In searching for the rust an interesting fact was brought out in conection with the distribution and spread of the fungus. In every case he affected plants were found in spots scattered here and there in the lat. Frequently 25 or 30 plants growing together would be found adly rusted, while plants all around would be perfectly free from the lisease. Again a single plant in a plat would be found showing peraps only one affected leaf. Observations made upon these rust areas evealed the fact that they acted as centers of infection, the parasite preading from them to adjoining plants and thence to other parts of he field.

Examining the weather record for ten days preceding the discovery of ust, we find nothing to warrant the belief that the simultaneous appearnce of the fungus the first week in May in widely separated spots was lue to peculiar climatic conditions. The weather conditions at this ime, so far as relates to temperature and rainfall, were not abnormal, s will be seen by consulting the table given below:

TABLE 3.—*Showing the daily mean temperature and daily precipitation at Garrett Park, Md., from April 20, 1892, to May 20, 1892.*

Date.	Temperature.	Precipitation.
Apr. 20	40	0.85
Apr. 21	44	1.30
Apr. 22	52	0.80
Apr. 23	54	Trace.
Apr. 24	55	....
Apr. 25	46	....
Apr. 26	49	....
Apr. 27	53	....
Apr. 28	62	....
Apr. 29	62	0.46
Apr. 30	58	....
May 1	62	....
May 2	62	Trace.
May 3	66	....
May 4	66	....
May 5	75	....
May 6	65	....
May 7	62	....
May 8	45	....
May 9	61	Trace.
May 10	50	....
May 11	64	0.69
May 12	56	....
May 13	57	....
May 14	56	0.69
May 15	56	Trace.
May 16	59	....
May 17	65	....
May 18	56	1.10
May 19	59	....
May 20	62	....

Seventeenth treatment (*May 16, 1892*).—No critical notes were made on the experiment at this time. All plats were sprayed and dusted in the usual way, and from 50 to 100 specimens were collected from each.

It was seen that the rust was spreading rapidly on all the plats except those treated every ten days with Bordeaux mixture, ammoniacal solution, ferrous ferrocyanide, cupric ferrocyanide, and copper borate. As far as could be determined from a superficial examination, the plats sprayed with the two first-named preparations and with ferrous ferrocyanide were wholly free from rust.

Another fungus appeared at this time, and for a while threatened to occasion as much damage as rust. Microscopic examination revealed the fact that this parasite was *Septoria graminum* Desm., a fungus known to occur on many grasses in various parts of the world. The leaves attacked by the *Septoria* show at first brownish elongated spots; these soon run together and eventually the leaf turns yellowish brown and shrivels up. In addition to the foregoing disease it was found that many lower leaves on every plant were turning yellow without the attacks of fungi or parasites of any kind. For a time the yellowing was thought to be a normal appearance due to old age, and to a certain extent this was probably the case. From the fact, however, that the yellowing was largely absent on the parts sprayed with Bordeaux mixture, ammoniacal solution, and ferrous ferrocyanide, it would appear that these treatments, either indirectly by their action on the soil, or directly by exerting some influence on the host, had enabled the first-formed leaves to perform their functions beyond the usual period. The explanation of the phenomenon, however, involves the discussion of physiological questions beyond the province of this paper. The only object in mentioning the matter at this point is to make clear the subsequent notes on the effects of the treatments. In view of the near approach of harvest it was decided to make no further treatments, but the observations were continued at intervals of four to eight days. These will be given under headings the same as in treatments.

Observations on May 24, 25, and 26, 1892.—Preparations were made on May 23 for a critical examination of every plat. A schedule of points to be noted was prepared and this was followed as nearly as possible throughout the examination. The schedule was as follows:

(1) *General condition.*—Under this heading three things were considered, namely, (*a*) size of plants, (*b*) color of plants, and (*c*) number of plants to the plat. On a scale of 100, size was made to count 50 points, color 30 points, and number of plants to the plat 20 points. The standard for size and number of plants to the plat was obtained from plants in an adjoining field. In considering color, the entire absence of yellow leaves, whether due to fungi or other causes, was taken as perfect, in this case giving 30 points.

(2) *Detailed condition.*—In this case six things were considered, namely: (*a*) Size of plants, (*b*) amount of rust, (*c*) amount of *Septoria graminum*, (*d*) amount of other fungi, (*e*) amount of yellow foliage, and (*f*) injury from the treatments. To obtain the size of the plants, measurements were made at three points in each plat and the average taken. It was planned to determine the amount of rust by an actual

count of the affected plants, but this was found to be out of the question, as it would have involved the counting of almost every stalk. When it was found that the rust was so widely distributed, a count of only a few of the more promising looking plats was made. The data on the amount of *Septoria*, yellow foliage, etc., was obtained by carefully examining the plats and marking the results in percentages. It is hardly necessary to give in detail the figures obtained as a result of the foregoing observations. Summarizing the data, it may be stated as follows:

(1) The general condition of all the original plats, with the exception of those treated with Bordeaux mixture, ammoniacal solution of copper carbonate, ferrous ferrocyanide, and copper borate, was the same, averaging 55 to 75 when compared with wheat in the field taken as 100. The poor condition of the wheat, treated as well as untreated, when compared with the ordinary field crop, was due to a number of causes, the most important being the omission of fertilizers in planting and the thinness of the plants due to necessary walks, alleys, etc. The condition of the plats sprayed with Bordeaux mixture, ammoniacal solution of copper carbonate, ferrous ferrocyanide, cupric ferrocyanide, and copper borate averaged 90 to 100, when compared with the field crop.

(2) The general condition of all the duplicate plats was 10 to 20 points lower than the original.

(3) There was no marked difference in the height of the plants in the various plats, the average for the originals being 18 to 30 inches and the duplicates 14 to 24 inches.

(4) The amount of rust on the various plats, as nearly as could be determined, was the same, fully 90 per cent of the plants in every case being affected. An actual count of the rusted plants in 13 plats gave the following results:

TABLE 4.—*Showing actual number of rusted plants on 14 plats.*

Plat.	Method of treating.	Number of plants showing rust.
1	Untreated	1,908
2	Soil treatment with sulphur	2,500
3	Untreated	1,910
4	Soil treatment with sulphur	2,368
5	Untreated	2,196
6	Soil treatment with sulphur	1,741
40	Sprayed with Bordeaux mixture every 10 days	2,716
41	Untreated	2,568
42	Sprayed with ammoniacal solution every 10 days	1,247
44	Sprayed with potassium sulphide solution every 10 days	2,729
46	Sprayed with Bordeaux mixture every 20 days	2,456
48	Sprayed with ammoniacal solution every 20 days	2,672
50	Sprayed with cupric ferrocyanide mixture every 10 days	2,736
52	Sprayed with ferrous ferrocyanide mixture every 10 days	2,548

Each of the foregoing plats contained from 2,600 to 3,400 plants.

(5) *Septoria graminum* occurred upon all the plats, from 5 to 10 per cent of the foliage being affected. It was worse where the plants were thick, and was almost entirely absent where, from the effects of the seed treatments and other causes, the plants were thin. Spraying with

Bordeaux mixture and ammoniacal solution of copper carbonate prevented this fungus to a large extent.

(6) All plants except those sprayed with Bordeaux mixture, ammoniacal solution, and ferrous ferrocyanide, showed from 5 to 20 per cent of yellow foliage. The above exceptions were practically free from the trouble.

(7) The injury to the plants resulting from the work was only marked in the case of the soil and seed treatments. These are referred to in detail in Table 2.

Observations on June 4, 1892.—From May 26 to June 4 rust rapidly increased; in fact, at the latter date not a leaf could be found that did not show the fungus. The lower leaves were in every case the more badly diseased; the rust sori, however, were found in great quantities on the very topmost leaves. All the fields in the neighborhood were badly rusted, in many cases the plants being literally red with the fungus. For the first time the teleutospores were found and upon examination it was seen that they possessed all the characteristics of those belonging to *Puccinia rubigo-vera.* No further field notes were made and on June 9 the crop was harvested. The crop on each plat was cut in the usual manner, after which each bundle was marked with a numbered tag, and shocked after the ordinary fashion. The weight of the straw and grain, weight of grain, and weight of straw were next determined. The straw and grain together were first weighed, then the latter was flailed out and weighed, thus giving the rest of the data. A careful study of these figures reveals so little of interest that it is deemed unnecessary to publish them in full. The yield was fairly even throughout the field, the only striking differences in this respect being where the plants were thin on account of certain seed and soil treatments, the injurious effects of which have already been pointed out. Summing up this phase of the subject, it may be said that so far as affecting the yield, except in the cases noted, the treatments had no appreciable effect.

SUPPLEMENTARY EXPERIMENTS IN THE TREATMENT OF RUST OF WHEAT AND OTHER CEREALS AT GARRETT PARK, MARYLAND.

As a supplementary experiment it was decided early in March, 1892, to spray spring-planted wheat, oats, and rye with a number of the standard fungicides, using full and half strength solutions. It was thought best to plant the grain as late as possible in order to invite the attacks of rust fungi. No harvest of course was expected. On May 17 fifty-seven plats, each 3 by 33 feet, were staked off. Thirty-six plats were planted with wheat, 12 with oats, and 9 with rye. In the case of each crop half of the plats were treated and half were left for control. The fungicides used were Bordeaux mixture, full and half strength, ammoniacal solution, full and half strength, sulphur and sulphosteatite. The Bordeaux mixture, full strength, contained 6 pounds of copper sulphate and 4 pounds of lime to 22 gallons of water. The ammoniacal solution was made by dissolving 2½ ounces

of copper carbonate in 1½ pints of ammonia then diluting to 25 gallons. The sulphur and sulphosteatite were used as described in the experiment with winter wheat, p. 202. The plants were treated at intervals of two, ten, and twenty days, respectively, from the time they appeared above ground until they were 8 inches high. Without going into the details of the work the results may be briefly summarized as follows:

(1) Rust appeared more or less on all the plats when the plants were from 2 to 5 inches high.

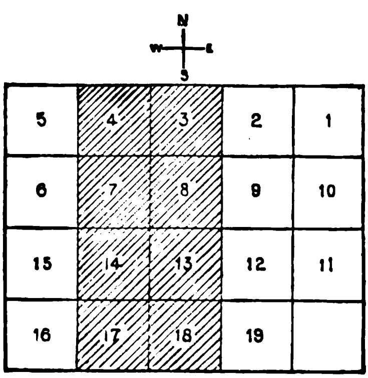
(2) The fungus was more abundant at first on the untreated plats and those dusted with flowers of sulphur and sulphosteatite. Despite the treatment, however, rust increased on every plat, and by the time the plants were 8 inches high there was no difference between the plats as regards the amount of the fungus.

In all cases where the liquids were used, soap was added to make them wet the leaves more thoroughly. It was found, however, exceedingly difficult to cover the foliage even when the sprayings were made every two days. In case of the oft-repeated treatments fully four-fifths of the leaf surface was frequently found wholly unprotected.

EXPERIMENTS AT MANHATTAN, KANS.

Mr. J. F. Swingle, to whom the work at this place was entrusted, conducted the experiments on his farm a mile and a half from the State Agricultural College. Early in September, 1891, Mr. Swingle was requested to select from an average field of wheat a block containing 8,000 to 10,000 square feet. This was done, and on October 13 the ground was platted. Nineteen plats were laid out, each 20 feet square, in 4 rows, extending east and west. The plat in the southeast corner was cut out in order to give the necessary number. The accompanying diagram shows the arrangement of the plats, and the explanation gives the treatment each received:

DIAGRAM 1.—*Showing plan of experiment at Manhattan, Kans.*



Explanation of Diagram 1.

Plats 1, 3, 5, 7, 9, 11, 13, 15, 17, and 19, untreated.

Plats 2, 8, and 14, sprayed every ten days with Bordeaux mixture, full strength, from the time the plants appeared above ground until harvest.

Plats 4, 10, and 16, sprayed every ten days with ammoniacal solution of copper carbonate, full strength, from the time the plants appeared above ground until harvest.

Plats 6, 12, and 18, sprayed every ten days with potassium sulphide solution, 2 ounces of potassium sulphide to 3 gallons of water, from the time the plants appeared above ground until harvest.

The land was rich bottom, having grown but one previous crop and that in 1891. By an accident a part of the field selected was plowed early in July. This part fortunately almost exactly coincided with plats 3, 4, 7, 8, 13, 14, 17, and 18. Mr. Swingle in commenting upon this point says:

In selecting the field of wheat I did not think of the early plowing a part of it received. This, as will be seen further on, had an important bearing on the yield of straw and grain. It so happened, however, that the lines running north and south and separating the early from the late plowing almost coincided with the lines separating certain plats. In considering the effect of the treatment, therefore, the plats plowed early should be compared with each other and not with those plowed late.

The sprayings were made with a knapsack pump and Vermorel nozzle, beginning on October 17 and ending June 13, no soap being used. On June 21, Mr. Swingle, acting under instructions from the writer, carefully examined the plats and estimated to the best of his ability the amount of rust on each. The figures obtained are set forth in the following table:

Table 5.—*Showing the per cent of rust on the treated and untreated plats June 21.*

Plat.	Kind of treatment.	Per cent of plants rusted.
1	Untreated	80
2	Bordeaux mixture	20
3	Untreated	90
4	Ammoniacal solution	95
5	Untreated	70
6	Potassium sulphide	75
7	Untreated	90
8	Bordeaux mixture	10
9	Untreated	70
10	Ammoniacal solution	75
11	Untreated	90
12	Potassium sulphide	40
13	Untreated	100
14	Bordeaux mixture	25
15	Untreated	75
16	Ammoniacal solution	75
17	Untreated	100
18	Potassium sulphide	75
19	Untreated	90

According to the foregoing estimate, the plats sprayed with Bordeaux mixture were much more free from rust than any of the others and potassium sulphide was better than ammoniacal solution. The early plowing did not seem to affect the results at all, so far as rust was concerned. Mr. Swingle was directed to collect material from all the plats and forward it to Washington for examination. This was done, and the

results of a critical study of the material showed that the estimate made in the field, regarding the amount of rust on each plat, was a conservative one. On June 27 and 28 the grain was harvested with a sickle, each plat being trimmed down beforehand to 16½ feet square. Nothing further was done with the grain until August 8, when the straw and grain were weighed and the latter threshed out with a flail.

The result of this work is set forth in the following table:

TABLE 6.—*Showing weight of straw and grain and weight of grain and of straw from each plat.*

Plat.	Kind of treatment.	Weight of straw and grain.	Weight of grain.	Weight of straw.
1	Untreated, late plowing	23	7	15
5	......do	23	7	15
2	Bordeaux mixture, late plowing	24	7	16
3	Untreated, early plowing	34	10	24
8	Bordeaux mixture, early plowing	34	11	23
14	......do	32	10	22
7	Untreated, early plowing	31	9	21
10	Ammoniacal solution, late plowing	28	9	19
11	Untreated, late plowing	17	5	8
4	Ammoniacal solution, early plowing	35	9	25
13	Untreated, early plowing	29	8	20
16	Ammoniacal solution, late plowing	24	8	15
19	Untreated, late plowing	15	5	9
12	Potassium sulphide, late plowing	19	6	13
9	Untreated, late plowing	20	7	13
18	Potassium sulphide, early plowing	33	10	23
15	Untreated, late plowing	20	6	13
6	Potassium sulphide, late plowing	25	7	17
17	Untreated, early plowing	32	9	23

The plats are arranged so as to bring those plowed early and late together, for the sake of more conveniently comparing them. A study of the figures reveals the fact that there are no very striking differences in favor of any of the treatments. Comparing the total yield of plats 8 and 14, sprayed with Bordeaux mixture, plowed early, with the the yield of plats 3 and 13, the nearest untreated plats, plowed early, it is seen that there is an increase of 3 pounds in the total yield and 3 pounds in the yield of grain in favor of the spraying. Plat 2, treated with Bordeaux mixture and plowed late, yielded only 1 pound more straw than plat 1, untreated. Compared with untreated plat 9, however, plat 2 yielded 3 pounds more straw for the same amount of grain. Where the plats were sprayed with the ammoniacal solution, there was an increase in every case of the treated over the untreated; in fact, the difference, between the sprayed and unsprayed plats was here more striking than where Bordeaux mixture was used. It is doubtful, however, if this increase was due to the prevention of rust, for, as shown in Table 5, these plats were almost as badly rusted as the untreated. It is barely possible that the increased yield was due to the fertilizing effect of the ammoniacal solution on the soil. The plats sprayed with potassium sulphide gave about the same amount of increase as those treated with the ammoniacal solution. There is no apparent reason for believing that the increase was due to the prevention of rust. On the other hand, there is some proof that increased fertility of the soil, due to the application of the potassium sulphide,

might have caused the difference noted. Summing up the results of this experiment, it may be said that so far as could be ascertained by a careful examination Bordeaux mixture did, to a considerable extent, prevent rust, but the other preparations had little or no effect on the disease. Furthermore in no case did the prevention of rust affect the yield to any appreciable extent.

EXPERIMENTS AT ROCKPORT, KANS.

Mr. Bartholomew's farm, where the experiments described in the following pages were conducted, is located in Rooks County, latitude 39° 30′ north and longitude 99° 20′ west. Three lines of work were carried on at his place, which may be designated as experiments A, B, and C, respectively.

EXPERIMENT A.

This experiment was, to a certain extent, the same as that conducted with winter wheat at Garrett Park, Md., there being ten kinds of soil treatment, seven of seed treatment, six treatments involving spraying, and six combining all three of the foregoing. The soil selected for the work was rich second bottom, so situated as to render the crops planted upon it peculiarly subject to the attacks of rust fungi. In accordance with instructions from the Department, Mr. Bartholomew early in October, 1891, staked off 132 plats, each 25 feet long and 4½ feet wide. From October 9 to 15 the wheat was planted, the variety known as "Turkey" being used. The grain was all planted in rows 9 inches apart, there being five rows in each plat. Eighteen inches were left between plats to serve as walks. The following is a tabular statement showing the treatment each plat received:

TABLE 7.—*Showing manner of treatment of plats in Experiment A, at Rockport, Kans.*

Plat.	Kind of treatment.
1 and 66	Untreated.
2 and 67	Soil treatment with flowers of sulphur, 5 ounces to 25 feet of row.
3 and 68	Untreated.
4 and 69	Soil treatment with flowers of sulphur, 2½ ounces to 25 feet of row.
5 and 70	Untreated.
6 and 71	Soil treatment with flowers of sulphur, 1¼ ounces to 25 feet of row.
7 and 72	Untreated.
8 and 73	Soil treatment with lime and sulphur, equal parts mixed, 5 ounces to 25 feet of row.
9 and 74	Untreated.
10 and 75	Soil treatment with lime and sulphur, equal parts mixed, 2½ ounces to 25 feet of row.
11 and 76	Untreated.
12 and 77	Soil treatment with powdered exsiccated ferrous sulphate, 5 ounces to 25 feet of row.
13 and 78	Untreated.
14 and 79	Soil treatment with 5 pints of water containing 5 ounces exsiccated ferrous sulphate to 25 feet of row.
15 and 80	Untreated.
16 and 81	Soil treatment with Bordeaux mixture, 5 pints to 25 feet of row.
17 and 82	Untreated.
18 and 83	Soil treatment with 5 pints of water containing 1¼ ounces potassium sulphide to 25 feet of row.
19 and 84	Untreated.
20 and 85	Soil treatment with 5 pints of ammoniacal solution of copper carbonate to 25 feet of row.
21 and 86	Untreated.
22 and 87	Seed immersed in water at 133° F. for 15 minutes.
23 and 88	Untreated.
24 and 89	Seed immersed in an 8:100 solution of copper sulphate for 24 hours, then limed.
25 and 90	Untreated.
26 and 91	Seed immersed for 24 hours in Bordeaux mixture.
27 and 92	Untreated.
28 and 93	Seed immersed for 24 hours in a 5:100 solution of potassium bichromate.
29 and 94	Untreated.

TABLE 7.—*Showing manner of treatment of plats in Experiment A, at Rockport, Kans.*—Continued.

Plat.	Kind of treatment.
30 and 95	Seed immersed for 24 hours in a solution of potassium sulphide, 1 ounce to 1 gallon of water.
31 and 96	Untreated.
32 and 97	Seed immersed for 24 hours in a solution of potassium sulphide, ½ ounce to 1 gallon of water.
32½ and 98	Untreated.
33 and 99	Untreated.
34 and 100	Seed immersed for 24 hours in a 1:1000 solution of corrosive sublimate.
35 and 101	Untreated.
36 and 102	Plants sprayed every 10 days with Bordeaux mixture.
37 and 103	Untreated.
38 and 104	Plants sprayed every 10 days with ammoniacal solution of copper carbonate.
39 and 105	Untreated.
40 and 106	Plants sprayed every 10 days with potassium sulphide solution, 2 ounces to 3 gallons of water.
41 and 107	Untreated.
42 and 108	Plants sprayed with Bordeaux mixture every 20 days.
43 and 109	Untreated.
44 and 110	Plants sprayed with ammoniacal solution of copper carbonate every 20 days.
45 and 111	Untreated.
46 and 112	Plants sprayed with potassium sulphide solution, 2 ounces to 3 gallons of water every 20 days.
47 and 113	Untreated.
48 and 114	Seed, soil, and spraying treatments. Seed immersed in Bordeaux mixture 24 hours; soil treated with 5 pints of Bordeaux mixture to 25 feet of row; plants sprayed with Bordeaux mixture every 10 days.
49 and 115	Untreated.
50 and 116	Seed, soil, and spraying treatments, with potassium sulphide solution, 2 ounces to 3 gallons of water. Seed immersed for 24 hours; soil treated with 5 pints to 25 feet of row; plants sprayed every 10 days.
51 and 117	Untreated.
52 and 118	Seed, soil, and spraying treatments. Seed immersed for 24 hours in ammoniacal solution of copper carbonate, plants sprayed every 10 days with the same preparation.
53 and 119	Untreated.
54 and 120	Seed and spraying treatments. Seed immersed for 15 minutes in water at 133° F.; plants sprayed every 10 days with Bordeaux mixture.
55 and 121	Untreated.
56 and 122	Seed and soil treatment. Seed immersed for 15 minutes in water at 133° F.; soil treated with lime and sulphur equal parts, 5 ounces to 25 feet of row.
57 and 123	Untreated.
58 and 124	Seed and soil treatment. Seed immersed in water at 133° F. for 15 minutes; soil treated with 2½ ounces ferrous sulphate to 25 feet of row.
59 and 125	Reserved for spring treatment.
60 and 126	
61 and 127	
62 and 128	
63 and 129	
64 and 130	
65 and 131	

The Bordeaux mixture and ammoniacal solution used throughout the foregoing experiment were full strength, *i. e.*, containing, respectively, 6 pounds of copper and 4 pounds of lime to 22 gallons of water, and 3 ounces of copper basic carbonate dissolved in 1½ pints of ammonia to 22 gallons of water. Soap was not used with any of the preparations. All of the soil and seed treatments were made before the grain was planted. Spraying began on October 28, and with the exception of three interruptions caused by cold weather and snow, was continued at the regular ten and twenty-day intervals until harvest. No rust appeared until May 24, but from this time on it increased very rapidly, every plat in the entire tract being attacked to a greater or less extent. Upon examination the fungus proved to be *Puccinia rubigo-vera*, the common species of western Kansas. In accordance with directions from the Department, Mr. Bartholomew made careful notes on the

various plats with respect to the effects of the treatments on rusts and other fungi. After harvesting, the total yield of straw and grain, the yield of straw, and the yield of grain were each ascertained. From this data the following notes on the general effect of the treatment on each plat were prepared by Mr. Bartholomew:

Plats 1 and 66.—Untreated. These were so near like all other untreated plats that their condition may be taken as a standard. Three fungi were noted upon the plants, viz, *Puccinia rubigo-vera* on nearly every leaf, *Puccinia graminis* on an occasional stalk, and *Septoria graminum* on many of the leaves, but causing no serious damage.

Plats 2 and 67, 4 and 69, 6 and 71.—Soil treatment with flowers of sulphur; yield of both straw and wheat above the average, but the red rust was noticeable on every plant, not, however, in destructive quantities, as the wheat was full and plump.

Plats 8 and 73, 10 and 75.—Soil treatment with sulphur and lime; showed the usual amount of rust, with an average product of wheat and straw.

Plats 12 and 77.—Soil treatment with sulphate of iron; showed the rust in average quantities and yielded a medium amount of grain.

Plats 14 and 79.—Soil treatment with ferrous sulphate in water; did not show as good results in yield as 12 and 77. The usual amount of rust was present.

Plats 16 and 81.—Soil treatment with Bordeaux mixture; showed normal amount of rust, and the yield fell considerably below the average.

Plats 18 and 83.—Soil treatment with sulphide of potassium solution; showed the usual mount of rust and yielded below the average.

Plats 20 and 85.—Soil treatment with ammoniacal solution of copper carbonate; seemed to produce a bad effect on the germination of the seed, as the stand was thin, badly rusted, and the yield much below the average.

Plats 22 and 87.—Hot-water treatment of seed; showed normal amount of rust and decreased yield.

Plats 24 and 89.—Seed treated by immersing for twenty-four hours in 8:100 solution of copper sulphate, then limed; showed usual amount of rust and a yield lower than the adjoining untreated plats.

Plats 26 and 91.—Seed treated by immersing for twenty-four hours in Bordeaux mixture; gave fairly good average results, but was rusted.

Plats 28 and 93.—Seed treated by immersing for twenty-four hours in a 5:100 solution of potassium bichromate; badly rusted and yield lower than the average.

Plats 30 and 95.—Seed treated by immersing for twenty-four hours in potassium sulphide solution; produced fair results, though rusted as usual.

Plats 32 and 97.—Treated the same as the preceding, but with solution only half as strong; yielded a very inferior crop, which was badly rusted.

Plats 34 and 100.—Seeds treated by immersing for twenty-four hours in 1:1000 solution of corrosive sublimate; injured the vitality of the seed and gave a very light yield, with usual amount of rust.

Plats 36 and 102.—Sprayed with Bordeaux mixture every ten days from October 28 until June 24; yielded above the average and were not nearly so badly rusted as the preceding numbers or as the adjoining untreated plats.

Plats 38 and 104.—Sprayed every ten days with ammoniacal solution of copper carbonate; also yielded in excess of the average and were very slightly rusted.

Plats 40 and 106.—Sprayed every ten days with sulphide of potassium solution, 2 ounces to 3 gallons of water; did not show as good results, yet produced better yields than the adjoining untreated plats, being more free from rust but not so free as the two preceding groups.

Plats 42 and 108.—Sprayed every twenty days with Bordeaux mixture; yielded results very similar to plats 36 and 102, but showed more rust.

Plats 44 and 110.—Sprayed every twenty days with ammoniacal solution; was not so successful as plats 38 and 104, treated every ten days with the same preparation.

Plats 46 and 112.—Sprayed every twenty days with potassium sulphide solution; gave little or no effect in preventing rust, but yielded better than the adjoining untreated plats.

Plats 48 and 114.—Seed, soil, and spraying treatments with Bordeaux mixture; seed immersed twenty-four hours, soil treated with one-half gallon to 20 feet of row, and plants sprayed every ten days. This treatment was well-nigh fatal, giving the lightest yield of any group in the whole tract; very little rust.

Plats 50 and 116.—The treatment of these plats was exactly the same as the preceding, only potassium sulphide was used instead of Bordeaux mixture. The results were very unsatisfactory and the yield light; very little rust.

Plats 52 and 118.—Seed, soil, and spraying treatments with ammoniacal solution of copper carbonate; plants sprayed every ten days and soil treated with 2 gallons of the solution to 20 feet of row; not much rusted; yield normal.

Plats 54 and 120.—Seed and spraying treatment, the latter every ten days with Bordeaux mixture, the former with hot water; slightly rusted; very similar to the preceding group.

Plats 56 and 122.—Seed and soil treatment; hot-water treatment for seed; 2 ounces flowers of sulphur and 2 ounces air-slaked lime mixed to 20 feet of row for soil. The yield was about up to the average, but no appreciable lessening of the rust could be detected.

Plats 58 and 124.—Seed and soil treatment; hot-water treatment for seed; 2½ ounces ferrous sulphate to 25 feet of row for soil; normal yield, but no diminution of rust.

The following plats, as already indicated, were held for spring treatment:

Plats 60 and 126.—Sprayed with Bordeaux mixture; the yield was good and the rust was considerably less than on the adjoining untreated plats.

Plats 62 and 128.—Sprayed on the same dates as the last 2 plats, with ammoniacal carbonate of copper solution; very similar to the preceding group in all respects.

Plats 64 and 130.—Sprayed at the same time as 62 and 128, with potassium sulphide solution, 2 ounces to 3 gallons of water; this spraying was deleterious and decreased the yield noticeably; it had little effect in preventing rust.

In the following table is shown the yield of straw and grain for each plat and its duplicate:

TABLE 8.—*Showing kind of treatment and yield of grain and straw.*

Plat.	Kind of treatment.	Yield of grain and straw.		Yield of cleaned grain.	
		Lbs.	*Oz.*	*Lbs.*	*Oz.*
1 and 66	Untreated	11	2	2	2
	......do	9	9	1	10
2 and 67	Soil treatment with flowers of sulphur, 5 ounces to 25 feet of row	12	12	3	2
		11	4	2	12
3 and 68	Untreated	9	12	1	12
	......do	9	6	1	12
4 and 69	Soil treatment with flowers of sulphur, 2½ ounces to 25 feet of row	11	14	2	6
		11	4	2	4
5 and 70	Untreated	10	13	2	0
	......do	10	13	1	14
6 and 71	Soil treatment with flowers of sulphur, 1½ ounces to 25 feet of row	12	0	2	8
		11	8	2	4
7 and 72	Untreated	10	4	2	2
	......do	10	0	2	0
8 and 73	Soil treatment with lime and sulphur, equal parts mixed, 5 ounces to 25 feet of row	10	10	2	6
		10	5	2	2
9 and 74	Untreated	9	0	1	10
	......do	9	9	2	0
10 and 75	Soil treatment with lime and sulphur, equal parts mixed, 2½ ounces to 25 feet of row	13	5	2	8
		11	4	2	2
11 and 76	Untreated	9	14	1	12
	......do	10	10	1	12
12 and 77	Soil treatment with powdered ferrous sulphate, 5 ounces to 25 feet of row	10	0	1	10
		11	6	2	2

Table 8.—*Showing kind of treatment and yield of grain and straw*—**Continued.**

Plat.	Kind of treatment.	Yield of grain and straw.		Yield of cleaned grain	
		Lbs.	*Oz.*	*Lbs.*	*Oz.*
13 and 78	Untreated	12	4	2	4
	do	11	6	2	0
14 and 79	Soil treatment with 5 pints of water containing 5 ounces	9	2	1	8
	of ferrous sulphate to 25 feet of row	9	14	1	12
15 and 80	Untreated	10	4	1	14
	do	9	10	1	10
16 and 81	Soil treatment with 5 pints of Bordeaux mixture to 25	9	6	1	15
	feet of row	9	4	1	15
17 and 82	Untreated	10	6	2	0
	do	9	8	1	12
18 and 83	Soil treatment with 5 pints of water containing 1½ ounces	9	8	1	10
	of potassium sulphide to 25 feet of row	10	8	1	12
19 and 84	Untreated	10	10	1	14
	do	8	12	1	8
20 and 85	Soil treatment with 5 pints of ammoniacal solution of	7	10	1	6
	copper carbonate to 25 feet of row	9	8	1	12
21 and 86	Untreated	10	8	1	14
	do	10	4	1	15
22 and 87	Seed immersed in water at 133° F. for 15 minutes	7	8	1	9
		10	12	2	0
23 and 88	Untreated	10	12	2	2
	do	10	6	2	0
24 and 89	Seed immersed in an 8:100 solution of copper sulphate	7	10	1	6
	for 24 hours, then limed	10	0	1	14
25 and 90	Untreated	11	0	2	6
	do	10	12	2	5
26 and 91	Seed immersed for 24 hours in Bordeaux mixture	11	0	2	6
		11	0	2	4
27 and 92	Untreated	10	0	2	0
	do	10	4	2	3
28 and 93	Seed immersed for 24 hours in a 5:100 solution of potassium bichromate	9	0	2	0
		9	8	2	2
29 and 94	Untreated	10	10	2	5
	do	10	0	2	0
30 and 95	Seed immersed for 24 hours in a solution of potassium	10	2	2	2
	sulphide, 1 ounce to 1 gallon of water	10	4	2	6
31 and 96	Untreated	11	8	2	6
	do	11	0	2	0
32 and 97	Seed immersed for 24 hours in a solution of potassium	8	4	1	10
	sulphide, ½ ounce to 1 gallon of water	8	0	1	12
32½ and 98	Untreated	11	6	2	2
	do	11	4	2	4
33 and 99	do	10	8	2	2
	do	9	12	1	13
34 and 100	Seed immersed for 24 hours in a 1:1000 solution of corrosive sublimate	9	10	1	14
		5	9	1	2
35 and 101	Untreated	10	9	2	4
	do	10	6	2	4
36 and 102	Plants sprayed every 10 days with Bordeaux mixture	11	13	2	12
		11	6	2	3
37 and 103	Untreated	11	2	2	0
	do	9	12	1	12
38 and 104	Plants sprayed every 10 days with ammoniacal solution	12	2	2	8
	of copper carbonate	10	12	2	6
39 and 105	Untreated	9	12	1	10
	do	10	8	2	2
40 and 106	Plants sprayed every 10 days with potassium sulphide	10	10	2	1
	solution, 2 ounces to 3 gallons of water	10	12	2	6
41 and 107	Untreated	9	12	1	11
	do	10	4	1	12
42 and 108	Plants sprayed every 20 days with Bordeaux mixture	12	4	2	8
		10	10	2	4
43 and 109	Untreated	9	10	1	11
	do	11	4	2	5
44 and 110	Plants sprayed with ammonical solution of copper car-	10	8	1	12
	bonate every 20 days	9	14	1	12
45 and 111	Untreated	9	6	1	14
	do	9	6	1	10
46 and 112	Plants sprayed with potassium sulphide solution, 2	10	4	1	12
	ounces to 3 gallons of water every 20 days	9	6	1	9
47 and 113	Untreated	8	2	1	5
	do	8	12	1	7
48 and 114	Seed, soil, and spraying treatments; seed immersed in Bordeaux mixture 24 hours; soil treated with 5 pints of Bordeaux mixture to 25 feet of row; plants sprayed with Bordeaux mixture every 10 days	6	2	1	4
		5	2	1	0
49 and 115	Untreated	10	8	2	0
	do	9	12	1	14

TABLE 8.—*Showing kind of treatment and yield of grain and straw*—Continued.

Plat.	Kind of treatment.	Yield of grain and straw.		Yield of cleaned grain.	
		Lbs.	*Oz.*	*Lbs.*	*Oz.*
50 and 116	Seed, soil, and spraying treatments with potassium sulphide solution 2 ounces to 3 gallons of water; seed immersed for 24 hours; soil treated with 5 pints to 25 feet of row; plants sprayed every 10 days	7	12	1	6
		6	7	1	2
51 and 117	Untreated	10	0	1	12
	......do	10	4	1	10
52 and 118	Seed, soil, and spraying treatments; seed immersed for 24 hours in ammoniacal solution of copper carbonate; plants sprayed every 10 days with the same preparation	9	14	2	0
		10	12	2	5
53 and 119	Untreated	10	6	2	0
	......do	9	0	1	11
54 and 120	Seed and spraying treatments; seed immersed for 15 minutes in water at 133° F.; plants sprayed every 10 days with Bordeaux mixture	10	4	2	4
		9	2	1	9
55 and 121	Untreated	10	2	1	14
	......do	10	4	2	5
56 and 122	Seed and soil treatment; seed immersed for 15 minutes in water at 133° F.; soil treated with lime and sulphur, equal parts, 5 ounces to 25 feet of row	10	6	1	8
		11	12	1	14
57 and 123	Untreated	11	0	2	8
	......do	10	10	2	4
58 and 124	Seed and soil treatments; seed immersed in water at 133° F. for 15 minutes; soil treated with 2¼ ounces of ferrous sulphate to 25 feet of row	10	4	2	2
		10	6	2	0
59 and 125	Untreated	10	8	2	8
	......do	10	10	2	6
60 and 126	Reserved for spring treatments, but sprayings were not made	10	14	2	8
		10	12	2	9
61 and 127	......do	10	0	1	14
	......do	10	12	2	4
62 and 128	......do	10	4	2	1
	......do	11	4	2	4
63 and 129	......do	11	8	2	6
	......do	11	0	2	1
64 and 130	......do	9	8	1	8
	......do	10	0	1	13
65 and 131	......do	11	4	2	8
	......do	9	10	1	12

In commenting upon this table, Mr. Bartholomew says:

The total weight of straw and grain on the entire tract was 1,528 pounds, the 62 untreated plats yielding 797 pounds, and the 58 treated ones 731 pounds. The average yield per plat for the former was 11.72 pounds and for the latter 11.32 pounds. The total yield of cleaned grain was 258 pounds, being 133 pounds for the untreated and 125 pounds for the treated.

The average yield on both classes was almost exactly the same, viz, 1.95 pounds per plat. This shows a difference in favor of the treated plats in the matter of grain when we consider that the average product of these plats was about one-third of a pound less per plat, and that a number of the plats were greatly injured by the treatment as indicated in the table, showing a marked decrease in the production of both grain and straw. Doing away with the passage ways between the plats and presuming the rows to be 9 inches apart over the whole tract, this would indicate a yield of about 17 bushels per acre, which is in marked contrast with the adjoining field, where the yield was 30 bushels. Of course in the field the conditions were quite different. The seed was sown broadcast among cornstalks and thoroughly cultivated in with a fine shovel cultivator, and stood very thick all over the ground.

Another rather peculiar thing must be noted regarding conditions. The preparation of the ground consisted in cultivating and thoroughly harrowing the land, which placed it in excellent condition for seeding. A good crop of corn was raised on the land. This was cut and carried off before the cultivating and harrowing. The whole plat was very smooth, so much more so, in fact, than the adjoining field, that it proved an excellent playground for dozens of jack rabbits. Many of the young plants were

actually pulled out by the roots by these animals. Had it not been for this aggravating cause I have no doubt that the yield in straw and grain would have reached an average of 13 pounds per plat.

My conclusions regarding the efficacy of the various treatments are easily drawn. I have little hesitancy in saying that the several soil and seed treatments, so far as the prevention of rusts are concerned, were practically valueless. The sulphur treatments were productive of good results in an increase of yield but with that the matter stops. The success, whatever there is of it, has been all attained through spraying. While it is true that no plat was entirely free from rust, it is nevertheless a fact that its ravages were reduced to a minimum on the ten-day plats sprayed with Bordeaux mixture and ammoniacal solution of copper carbonate. I think the potassium sulphide solution should be discarded, as it seems to have a deleterious effect wherever applied. This was especially apparent, as will be noted, in Experiment B. Last fall I thought that the Bordeaux mixture when applied to very young plants had a deleterious effect, but my observations this season have led me to conclude that when properly applied no harm follows.

Experiment B.

The object of this work was to test the effect of eleven preparations as preventives of rust when applied to spring wheat and oats in the form of spray beginning when rust first appeared. The preparations used were as follows:*

Table 9.—*Showing the composition of the fungicides used.*

No. 26	Basic cupric acetate mixture:	
	Cupric acetate (refined powder)	47.6 grams
	Water	15144.0 grams.
No. 27	Copper borate mixture:	
	Cupric sulphate	59.6 grams.
	Sodium borate (borax)	65.5 grams.
	Water	15144.0 grams.
No. 28	Cupric ferrocyanide mixture:	
	Cupric sulphate	59.6 grams.
	Potassium ferrocyanide (yellow prussiate of potash)	89.4 grams.
	Water	15144.0 grams.
No. 29	Cupric hydroxide mixture:	
	Cupric sulphate	59.6 grams.
	Potassium hydrate	107.2 grams.
	Water	15144.0 grams.
No. 30	Tricupric orthophosphate mixture:	
	Cupric sulphate	59.6 grams.
	Sodium phosphate	104.2 grams.
	Water	15144.0 grams.
No. 31	Cupric polysulphide mixture:	
	Cupric sulphate	59.6 grams.
	Potassium sulphide (liver of sulphur)	59.6 grams.
	Water	15144.0 grams.
No. 32	Ferrous ferrocyanide mixture:	
	Ferrous sulphate exsiccatus	91.7 grams.
	Potassium ferrocyanide	183.5 grams.
	Water	15144.0 grams.
No. 33	Iron borate mixture:	
	Ferrous sulphate exsiccatus	91.7 grams.
	Sodium borate (borax)	367.0 grams.
	Water	15144.0 grams.
No. 34	Iron sulphide mixture:	
	Ferrous sulphate exsiccatus	91.7 grams.
	Potassium sulphide (liver of sulphur)	367.0 grams.
	Water	15144.0 grams.
No. 35	Zinc borate mixture:	
	Zinc sulphate	133.4 grams.
	Sodium borate (borax)	133.4 grams.
	Water	15144.0 grams.
No. 38	Bordeaux mixture, weak strength:	
	Cupric sulphate	10.4 grams.
	Lime (stone)	2.5 grams.
	Water	15144.0 grams.

* The numbers here are the original ones given by my assistants to the preparations for convenience of reference.

In addition to the foregoing there was one soil and seed treatment with Bordeaux mixture, the seed being immersed for twenty-four hours in the preparation and the soil treated with one-half gallon of the mixture to 20 feet of row. For the experiment as a whole 100 plats, each 3 by 15 feet, were used. Fifteen of the plats were planted with wheat and the same number with oats. For seed, White Mediterranean wheat, and Black Winter oats were used, each being planted on April 8, 1892. On June 4 *Puccinia rubigo-vera* was noticed on a few plants of wheat, thereupon each plat received the following treatment:

TABLE 10.—*Showing kind of treatment given each plat in Experiment B.*

Plat.	Kind of treatment.
1 and 1	No treatment.
26 and 26	Sprayed with basic cupric acetate mixture.
2 and 2	No treatment.
27 and 27	Sprayed with copper borate mixture.
3 and 3	No treatment.
28 and 28	Sprayed with cupric ferrocyanide mixture.
4 and 4	No treatment.
29 and 29	Sprayed with cupric hydroxide mixture.
5 and 5	No treatment.
30 and 30	Sprayed with tricupric orthophosphate mixture.
6 and 6	No treatment.
31 and 31	Sprayed with cupric polysulphide mixture.
7 and 7	No treatment.
32 and 32	Sprayed with ferrous ferrocyanide mixture.
8 and 8	No treatment.
33 and 33	Sprayed with iron borate mixture.
9 and 9	No treatment.
34 and 34	Sprayed with iron sulphide mixture.
10 and 10	No treatment.
35 and 35	Sprayed with zinc borate mixture.
11 and 11	No treatment.
38 and 38	Sprayed with Bordeaux mixture.
12 and 12	No treatment.
24 and 24	Soil and seed treatment with Bordeaux mixture.

Additional sprayings were made on June 6, 16, and 20, and July 5, respectively. The oats were harvested on July 16 and the wheat two days later. Mr. Bartholomew furnished the following notes on the effect of each treatment, the numbers given being those of the preparation and not the plats:

The condition of the untreated plats with respect to rust was very similar to those in Experiment A, all being quite uniformly affected with the fungus. The total yield for the 26 untreated plats was as follows:

Straw and grain ....pounds..	89½
Cleaned grain ....do....	13¾
Straw and grain per plat....do....	3½
Cleaned grain per plat....ounces..	8½

No. 26.—Basic cupric acetate mixture. Almost *entirely* free from rust; yield considerably above the average, viz, 4 pounds, and 4 pounds, 10 ounces per plat. The adjoining untreated plats were covered with red rust from bottom to top.

No. 27.—Copper borate mixture. Very similar to 26, being free from rust and the yield above the average.

No. 28.—Cupric ferrocyanide mixture. Below the average in yield, being injured by the fungicide; straw and grain light; can not recommend this preparation.

No. 29.—Cupric hydroxide mixture. Yield above the average and remarkably free from rust.

No. 30.—Tricupric orthophosphate mixture. The same as the last.

No. 31.—Cupric polysulphide mixture. Quite free from rust and produced the best yield on the tract, viz, 4 pounds, 8 ounces, and 4 pounds, 10 ounces per plat.

No. 32.—Ferrous ferrocyanide mixture. A practical failure, yielding very lightly in straw and almost no grain. This preparation should certainly be discarded. It is, however, a good weed destroyer, and would be good where weeds or grass are to be kept permanently down about trees or shrubs. No weeds came up on these plats after harvest, while on all the rest more or less weeds appeared.

No. 33.—Iron borate mixture. Yield normal, but plats considerably rusted. Would not recommend this preparation.

No. 34.—Iron sulphide mixture. A decided failure, producing very unsatisfactory results. If full strength had been used scarcely a green stalk would have been left by the fourth spraying, but after the second spraying the preparation was used half strength and was even then too severe. Very little rust.

No. 35.—Zinc borate mixture. Yield good; quite free from rust, though not as perfectly free as some of the preceding numbers.

No. 38.—Bordeaux mixture. Yield of straw good, but grain light. My experience with Bordeaux is that it has a decided effect on the common red rust as indicated not only in this experiment, but in "A" also. These plats were nearly free from rust.

No. 24.—Seed immersed 24 hours in Bordeaux; one-half gallon of the mixture to 20 feet of row for soil; treatment showed as much rust as any untreated plat. The product was above the average in straw and grain.

One thing particularly noticeable at the time of threshing was the fact that in such treatments as 26, 27, 29, 30, 31, and 38 the lower leaves were full and abundant, while in the untreated plats they were mostly thin, shrunken, or fallen off. Could these results be made to obtain throughout a field, it occurs to me that the feeding value of a ton of straw would be greatly increased. As a whole, these experiments were far more satisfactory than those described under "A."

In the following table the yield of the several treated spring wheat plats is given:

TABLE 11.—*Showing method of treatment and yield of grain and straw.*

Plat.	Kind of treatment.	Yield of grain and straw.		Yield of cleaned grain.
		Pounds.	*Ounces.*	*Ounces.*
26 and 26	Sprayed with basic cupric acetate mixture	4 4	0 10	10 12
27 and 27	Sprayed with copper borate mixture	4 4	3 6	9 9
28 and 28	Sprayed with cupric ferrocyanide mixture	3 3	2 8	6 8
29 and 29	Sprayed with cupric hydroxide mixture	3 4	12 0	8 9
30 and 30	Sprayed with tricupric orthophosphate mixture	4 4	0 4	9 11
31 and 31	Sprayed with cupric polysulphide mixture	4 4	10 8	10 11
32 and 32	Sprayed with ferrous ferrocyanide mixture	3 3	4 0	7 6
33 and 33	Sprayed with iron borate mixture	3 3	0 8	7 8
34 and 34	Sprayed with iron sulphide mixture	3 3	6 3	7 6
35 and 35	Sprayed with zinc borate mixture	4 3	2 12	10 10
38 and 38	Sprayed with Bordeaux mixture	3 4	14 6	8 9
24 and 24	Soil and seed treatment with Bordeaux mixture	4 3	2 10	9 8

It appears from the foregoing that the total yield of straw and grain on the 24 treated plats was 82 pounds, an average of 3.41 pounds per plat. The total yield of cleaned grain was 13 pounds, an average of 8¾ ounces per plat. The total averages in this case do not differ materially from those where no treatments were made. It should be borne in mind, however, that there were 2 more plats in the untreated lot than in the treated; also, that a number of the treated plats were so seriously injured that the yield was very light. Taking out of consideration the reduction in the crop due to the foregoing causes, the treated plats gave a somewhat higher average yield than the untreated.

The results in the treatment of oats were wholly negative, as no rust whatever appeared on any of the plats. It may be of interest to say, however, that several of the preparations, notably Nos. 32 and 35, seriously injured the plants. As a result of this the yield of the treated plats was nearly 10 per cent less than the untreated.

EXPERIMENT C.

Experiment C consisted of spraying 1 plat each of late-planted spring wheat and oats with Bordeaux mixture, full strength, combined with soap. It was thought that possibly rust would not appear in experiments A and B; consequently the late spring grains, which are almost invariably attacked by the disease, were put in. Each plat was 33 feet long and 3 feet wide, there being 2 in each case, 1 for treatment and 1 for control. The sowing was not done until May 20, but the weather was so warm that the plants were well up by the 30th of the same month. Six treatments in all were made, the dates being May 30, June 3, 6, 16, and 25, and July 5, respectively. No rust of consequence appeared on any of the plats, consequently the results so far as concerned the prevention of this disease were negative.

CONCLUSION.

The work described in the foregoing pages, carried on under widely different conditions of soil and climate, seems to clearly indicate that treating the seed and soil previous to planting with various chemicals and with hot water is of no value whatever so far as the prevention of rust is concerned. This accords with our knowledge of the life history of the rust fungi attacking cereals, and bears out the generally accepted belief of those who have studied the matter. Many of the soil and seed treatments were positively injurious, diminishing the crop to a far greater extent than all the diseases observed combined.

The spraying treatments did, in some cases at least, diminish the amount of rust and seemingly increased the yield of straw and grain. A slight increase of yield in an experiment of this kind, however, must be looked upon with a good deal of suspicion, as there are many things that might influence the matter one way or another. On the whole

there seems no good reason for believing that spraying, even with the most improved methods with which we are now familiar, would be practicable or profitable on a large scale. At Garrett Park, where this kind of work was done with the greatest care and where every precaution was taken to make the various preparations cover the foliage, rust was just as abundant on the sprayed as on the unsprayed wheat. A critical study of the plants in the field afforded what seems a satisfactory explanation of the foregoing fact. On examining the leaves immediately after they had been sprayed in the most careful manner, it was found that fully one-half of the surface was wholly free from any signs of the liquid put on. The shape of the leaf, its position on the stem, manner of growth, and waxy covering, all conspire to render it exceedingly difficult to wet, and unless thoroughly wetted or covered by the fungicide there is little hope of preventing the reproductive bodies of the rust fungi from gaining an entrance.

Finally, it may be said that while improved machinery and fungicides and improved methods may make it possible to profitably spray our cereals, with our present means this can not be done. The work, however, should not be abandoned; on the contrary, it should be continued until the matter is definitely settled one way or the other. At the same time the far more promising work of breeding rust-resisting varieties should be taken up and carried forward along such lines as offer the most promising results.

ADDITIONAL NOTES ON PEACH ROSETTE.

By Erwin F. Smith.

I.—SPREAD OF THE DISEASE.

The peach rosette continues in Georgia and has appeared in South Carolina. Mr. W. L. Anderson, of Ninety-six, sent specimens from his peach orchard, and wrote as follows, under date of June 14, 1892:

> In the summer of 1890 I noticed some of the peach trees turning yellow; but, from information at hand, concluded it was not what is called the yellows. The trees (3) died, root and branch. No sprouts have ever put forth from the old roots of any of these or other trees since attacked. Last year I lost 6 trees from the same disease. This year I cut down 8 as soon as I noticed the peculiar growth of the leaves. I have 2 left, some one-fourth mile apart. They are, at this writing, evidently moribund and will be dead in another month.

Mr. Anderson states that several of his neighbors have lost trees, and that the disease is entirely new to him, although he has lived in that region and been interested in peach-growing for a long time.

Some field work begun in Georgia in 1890 and 1891, could not be reported upon fully in Bulletin 1,* because incomplete or only just begun

* Div. Veg. Pathology, U. S. Dept. of Agr., 1891.

when that report went to press. A year has passed and certain additional conclusions may now be drawn with confidence.

The experiments are as follows:

II.—FIELD EXPERIMENTS IN GEORGIA.

I. *Peach on Marianna plum stock—Buds from the healthy-looking side of a rosetted peach tree.*—This experiment was made to determine whether the disease was latent in the healthy-looking side of the affected trees, and would afterwards appear in buds cut from the same and inserted into healthy stocks. The buds were set July 1, 1890. The condition up to the fall of 1891 of the trees grown from these buds is given under Experiment 2 (Bull. No. 1, p. 56). These trees were reëxamined October 31, 1892. All of them were still free from rosette. The buds have now been set twenty-eight months and have grown into vigorous tops, so that there can no longer be any doubt that the north part of the parent tree was entirely free from taint of disease at the very time that the south part was badly affected. The rest of this tree became diseased the following season and is now dead.

II. *Marianna plum stocks inoculated with buds taken from rosetted peach trees.*—This experiment was made to determine whether the peach and plum rosette are identical. For this experiment and the next about 250 trees were selected from 5 nursery rows on the farm of William Warder, Griffin, Ga. These trees were propagated from cuttings and were 1½ years old at the beginning of the experiment. Two rows were inoculated and 3 were held for comparison. June 8, 1891, 104 of these trees were inoculated with buds cut from 6 or 8 of the badly rosetted young trees described in Experiment 1 (Bull. No. 1). One to two buds were inserted into each tree in the usual way. November 13, 1891, all were free from rosette. At that time the condition of the inserted buds was as follows: In 42 trees the buds had healed on and were still alive in whole or part, but only 2 had grown into shoots, and both were feeble—only ½ and 1 inch long. In 2 or 3 trees the unions were doubtful. In the rest the buds failed to unite with the stocks. There is no question, therefore, but that in more than one-third of the trees an organic union had taken place between the plum stocks and the rosetted buds. Only five months had elapsed and it was thought that perhaps a longer period might be necessary to infect plum from peach than had been found necessary in case of peach on peach. These trees were reëxamined November 1, 1892, *i. e.*, more than sixteen months from the date of inoculation, and all were still free from rosette. There is, therefore, good reason to believe that the Marianna plum is not subject to this disease.

III. *Marianna plum stocks inoculated with buds taken from a rosetted Kelsey plum.*—This experiment was made to determine whether the plum rosette could be transmitted to plums. The trees used for these

experiments formed part of the block described under II. The buds were inserted the same day under like conditions. They were taken on the Wayman farm, from a Kelsey plum which was badly affected in all parts. Only 12 trees were budded. On November 13, 1891, it was found that the diseased buds had healed on to 4 trees, and were still living. On the others they had been thrown out. There were no cases of rosette. The trees were reëxamined November 1, 1892. All were free from rosette. This is the only experiment yet undertaken to determine whether this disease can be transmitted from plums to plums.

IV. *Peach stocks inoculated with buds taken from rosetted Kelsey plums.*—This experiment was made to determine whether the plum rosette could be transmitted to peach trees. Two rows of nursery trees, 37 in all, consisting of Elberta tops on seedlings of the same age as in V, were selected for this experiment. This formed part of the nursery described in Experiment 1 (Bull. No. 1). Scions were cut from two badly diseased Kelsey plums, which stood on the same farm about ½ mile distant. The inoculations were made June 20, 1891, and two buds were inserted into each stock. November 12, 1891, an examination showed that some part of one or both buds had united with the stock in 22 cases, and was still alive. In 3 trees the union was doubtful, and in 12 both buds failed to unite. At this date all were healthy with exception, possibly, of 1 tree, which had begun to look suspicious. The inoculated buds were very feeble, and in no case did they grow into branches. Here, then, an organic connection was established between the buds and stocks in two-thirds of all the trees. October 29, 1892, these trees were reëxamined with the following result: Many of the buds which had healed on were still alive. Two trees were dug out in summer, and may have shown symptoms of rosette, but this is doubtful. One of these was the tree marked as suspicious in the fall of 1891. Two trees developed rosette in the spring, in all parts, and died in August. The rest were healthy in spite of the fact that sixteen months had passed since the insertion of the diseased buds. Both the rosetted trees were inoculated from the same plum; both the missing trees from the other plum.

The small per cent of cases to unions makes it necessary to repeat this experiment before it can be stated positively that the plum disease is identical with that of the peach and transmissible to it, as seems very probable from its appearance.

V. *Root inoculations, peach on peach.*—This experiment was made to determine whether the disease could be transmitted from roots to roots, and incidentally to throw some light on the possibility of natural infection through the soil. Sixty young trees were selected for this purpose. They stood in the same nursery and were planted the same time as the five rows inoculated in 1890 and described in Experiment 1 (Bull. No. 1, p. 49), but bore Elberta tops. The collars of the trees in two rows were uncovered and all trees badly infested by borers were destroyed.

The remainder were then inoculated, June 20, 1891, as follows: The earth was carefully removed from one of the roots and a T–shaped incision was made down to the pericambium. A root about ¼ inch in diameter was then selected from a rosetted tree and a curved cut made through the bark down to the pericambium, parallel to it for about an inch, and then out again, in some cases including a thin shaving of wood. This graft was then crowded beneath the lips of the T–shaped cut and bound into place. The earth was then returned. These root grafts came from 15 badly rosetted trees, and each one was taken from a separate root. Each tree furnished 4 grafts, making a total of 60. Presumably all of these roots were diseased, but such is not known to be the case. The inference rested on the fact that all of the leaves and shoot-axes were rosetted on each of the 15 trees. Nine of these trees were from Experiment 1 (Bull. No. 1), being seedlings in which the disease had been produced by the previous year's bud inoculations. The other 6 trees stood in a neighboring orchard, were 5 or 6 years old, contracted the disease naturally, and had been entirely healthy until the spring of 1891. The bark of the roots being much thicker than that of stems of the same size, considerable difficulty was experienced in getting the grafts into place, and consequently it was somewhat doubtful whether they would unite with the stock.

These trees were examined November 12, 1891, *i. e.*, four months and twenty-two days after the inoculation. All were free from rosette and healthy.* They were reëxamined October 31, 1892. The conditions above ground were as follows: Seven trees were rosetted in all parts and already dead, 52 trees were healthy, 1 had been killed by borers and termites. All of the rosetted trees were grafted from the artificially infected young trees. The 24 trees grafted from the naturally infected orchard trees remained sound. Three of the 7 rosetted trees were grafted from 1 tree, the other 4 were grafted from 4 other trees, making five sources of infection. After the above-ground conditions had been determined, the roots of each of the 60 trees were dug out, washed, and carefully examined. Although the grafting had taken place more than sixteen months previous, it was not difficult to find the scar, and in most cases the inserted graft was still in place. The result of this examination may be summed up as follows: In the 7 rosetted trees the inserted graft had healed on and become an organic part of the root. In 5 healthy trees a very small fragment of the graft may have healed on, but this was doubtful, and can only be settled, if at all, by microtome sections and a careful study. The remainder of the graft was unquestionably thrown out. In the rest, the inserted grafts wholly failed to unite with the root, but were generally in place in a shriveled or semi-decayed condition, the roots having healed under them.

The symptoms appeared on the rosetted trees in the spring—April

*In case of the above-ground inoculations of Experiment 1 (Bull. No. 1), more than 50 per cent of the trees developed symptoms in four months and twelve days.

or May. All of them showed symptoms at once in all parts, and all died in August. There were and have been no cases of rosette in the rest of the young Elbertas (about 4,000); there was only one case in that part of the orchard joining this nursery, and there were less than last year in the other orchards on this farm, *i. e.*, about 27 in a total of 10,000 trees. This makes it overwhelmingly probable that the results here detailed are to be ascribed to the inoculations and not to any outside influence.

This experiment is especially interesting for a number of reasons:

(1) The disease has now been communicated from artificially infected trees to healthy ones, *i. e.*, the infection has been carried a second remove from the orchard trees which were its original source. (Bull. No. 1.)

(2) The rosette can be communicated from root to root as well as from stem to stem.

(3) The root-inoculated trees did not develop symptoms as soon as those which were inoculated above ground the preceding year, probably because the contagion had a longer distance to travel through the tissues.

(4) The small per cent of infections in comparison with the results of 1891 (Bull. No. 1) is attributable to the smaller number of unions. There were unions on only 12 trees at most and the disease followed in every case where from one-half to the whole of the graft became firmly united to the root.

(5) In case of the five doubtful unions the grafts came from as many different trees, and it is possible that these fragments may not have contained the infectious material even if any part really united with the roots, which is also a matter of doubt.

(6) In the other 52 trees, as in 4 trees of Experiment 1, (Bull. No. 1), simple contact failed to induce the rosette, although in all cases the diseased tissue (young prosenchyma and pericambium) was bound down tightly on to the meristem of the root, and in several instances was found to have been inclosed and tightly squeezed, and even deeply buried between the growing tissues of the root.

VI. *Inoculations of young peach trees with micro-organisms derived from cultures.*—These experiments were made to determine whether micro-organisms were constantly or commonly present in diseased tissues, and whether pure cultures of any of them would induce the rosette. Numerous tube and plate cultures from rosetted trees were made at Griffin, Ga., by W. T. Swingle and myself, in the summer of 1891, with as great care as our limited facilities would permit. A number of interesting yeasts and bacteria were isolated from the tissues or appeared in the cultures as contaminations. Notes were made on the manner of growth and microscopic appearance, stained and unstained, of all these forms—about twenty—and pure cultures from the original colonies were used for purposes of inoculation.

A series of 20 young trees was inoculated on the farm of H. W. Hasselkus, east of Griffin, and a duplicate series was inoculated on the farm of J. D. Husted, at Vineyard. Some of the more promising organisms, *e. g.*, those which grew but feebly on the agar or gelatine, and those which occurred in the cultures most frequently, were also inserted into a row of young trees in the garden of Mr. Hasselkus in Griffin. Each tree was inoculated on the main axis above ground in three places and in three slightly different ways, as follows:

(1) A T-shaped slit was made through the bark, and one flap was separated from the cambium and slightly lifted. A mass of the organisms was then removed from the culture on the loop of a platinum wire and inserted into the wedge-shaped cavity between the wood and bark. The latter was then bound securely in place.

(2) Into a similar slit a bud cut from the same tree was inserted and bound in place as in ordinary budding, the inner bark of the bud having first been carefully smeared with the micro-organisms, so that bark of insert and wood of stock were brought into close contact with a thin layer of germs between.

(3) The third inoculation was made in the same way, *i. e.*, the inner surface of the insert was smeared with the germs, but the wood of the bud was not removed.

The platinum wire was flamed before each inoculation, and the work was carried on as rapidly and deftly as possible to avoid contaminations. The inoculations were made in Mr. Hasselkus's yard June 15 and 16, on his farm June 19, and at Mr. Husted's place June 22, 1891. These trees were examined in the fall of 1891, and again in the fall of 1892. None of them developed rosette or any symptoms suggestive of it. In some cases there was considerable swelling and flow of gum at the points of inoculation, but none of the trees died or became sickly. All of the trees made a good growth, and those belonging to Mr. Hasselkus grew enormously. Of course many of the buds were thrown out, but others healed on in spite of the coating of micro-organisms.

An experiment was also tried using scrapings and bruised fragments of diseased tissues as infective material, but it was in old trees on a small scale, and the results are not conclusive enough to make it worth reporting.

III.—CONCLUSIONS RELATIVE TO THE NATURE OF THIS DISEASE.

(1) Excluding a few doubtful cases, the disease was conveyed from peach to peach whenever an organic union took place between the diseased buds and the healthy stocks (two experiments—128 trees).

(2) In no case was the disease transmitted artificially by mere contact even when meristem was bound very closely to meristem (two experiments—56 trees).

(3) From the failure to induce rosette by simple contact it is prob-

able that the contagion does not enter the tree through ordinary wounds caused by men or animals.

(4) The fact that the disease can be transmitted artificially through the root system makes it probable that trees may also become infected naturally in this way.

(5) Experimental proof of the identity of the peach rosette and the plum rosette is still incomplete.

(6) None of the yeasts or bacteria found in the cultures made from diseased tissues produced the disease when inserted into the cambium, and it is probable that the disease is not due to such organisms.

(7) In both natural cases and those induced by budding, the disease progresses gradually from the point of infection until all parts of the tree are involved. Even when a tree shows symptoms in all parts at once, as is very often the case in early spring, we may assume that the cause of infection entered through the roots during the previous summer or autumn and was gradually diffused through the whole tree in the months immediately preceding the vernal symptoms, as was certainly the case in the seven root-grafted trees.

(8) The shortest period of incubation was about two months (Bull. No. 1, p. 49) and the longest period about ten months, but one-half of this longest period was the winter season, during which the trees were dormant.

(9) The disease is probably conveyed through the protoplasm and the failure to isolate any pathogenic yeast or bacterium suggests the possibility that the cause is some amœboid organism living in the protoplasm and so much resembling it as to be difficult of detection. Such an hypothesis would explain all the facts. That the disease is due to any chemical ferment or other readily soluble substance seems out of the question, for the upward and side movements of the water imbibed by the roots would certainly carry it to all parts of the growing tree within a few hours or a few days at longest. Moreover, such a substance possesses no indefinite power of multiplication. Whereas, in this disease a very small fragment will induce symptoms in a whole tree, any part of which will then induce the disease in another tree.

REMEDIES FOR THE ALMOND DISEASE CAUSED BY CERCOSPORA CIRCUMSCISSA, SACC.

By Newton B. Pierce.

[Plates XVIII–XX.]

Since the publication of the author's former paper on the almond disease so prevalent in southern California,* spraying experiments have been conducted in Orange County, which have clearly demon-

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*Journal of Mycology, Vol. VII, No. 2, pp. 66–77.

strated that the disease may be controlled at moderate expense and in a thoroughly satisfactory manner. The suggestions of B. T. Galloway in regard to the treatment of this disease have proven of value.* From experiments now completed, and from additional facts gathered in relation to the habits of the parasite, there may now be outlined a very satisfactory plan of treatment.

The trees selected for the experiments were on the place of J. S. Baldwin, about 1 mile east of the village of Orange. They were badly infested by *Cercospora* in 1891, and had lost nearly all of their foliage by the latter part of July. By the 1st of August, 1892, the untreated trees were in worse condition than at the same date the preceding year, and only a few shoots had developed during the spring. There were 34 trees included in the experiment, and they formed a single row about 800 feet long, running from west to east through an orchard composed of various fruits. They were twelve years old and were grown on a soil of gray loam mixed with more or less gravel. The care given them has been but moderate. Many of the tops were well formed and of good size, while others were smaller and stunted in growth, owing to poorer soil. The branches, with the exception of a few terminal ones, were alive, but up to August 1 but little growth had been made and most of the wood of last season's growth was ready to die back. These trees leafed out fully in the spring of 1892 and received the first treatment in April.

Prior to the beginning of this season's work the almond foliage was supposed to be annually infected in the early spring by spores which came mainly from the fallen leaves of the previous year's growth. It has since been learned that infection of the spring foliage is mainly accomplished by means of spores produced on the terminal twigs of the tree, *i. e.*, on the last season's shoots. There is some evidence also that *Cercospora* may become nearly or quite biennial in its habits when living on almond branches. It even appears probable that in some cases it lives in the tissues of the twig through the mild winters of southern California and produces in the following spring a sufficient number of spores to infect the new foliage. Some observations seem to point to even a perennial life for the fungus, in rare cases. Be this as it may, it is evident from the way the tree first shows the disease in the spring that the new terminal leaves are infected directly from the last year's wood. Branches on all parts of the tree show disease first on the leaves at the end. This is as true of the uppermost limbs as of those next the ground, which would not be the case if the infecting spores came from either fallen foliage or the soil.

The spring infection is usually general over the outer branches, but in many cases it is more complete and the work of the fungus shows earlier on the north than on the south side of the tree. This may arise in part from the greater humidity on the north, due to shade, and the conse-

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Ibid., pp. 77–78.

quent conditions favorable to germination, and from the fact that the prevailing winds are from the southwest and naturally blow more spores to the north side of the tree.* It has already been noted that five-sixths of the infested points on the branches occur on the lower two-thirds. This is in harmony with the above facts, and arises from a like reason—the greater humidity on the shaded side.

After the parasite has become well developed on the outer leaves infected from the terminal twigs and abundant spore clusters are formed, the foliage toward the center of the tree becomes infected. The parasite spreads from the terminal leaves to those at the base of the limbs, and the fall of the diseased foliage follows essentially in the same order, although as the basal leaves are the older their fall is in consequence somewhat hastened.

From the preceding facts it will be seen that sprays applied after the outer leaves are infected, but before the fungus has matured fruit, may still prevent its spread to the main mass of foliage in the center of the tree. It is equally evident that if infection of the outer leaves is to be prevented the first application of fungicides should be made to the spore-bearing terminal twigs before the blossoms and new leaves have appeared. By this last method the spring infection of the leaves will be in the main prevented and the fungicide on the terminal twigs will destroy the germinating spores that have been formed there.

As it was not known in time that infection of the spring foliage was from the terminal twigs, the first application of sprays was not made until April 15, after the leaves were well formed. Hence some of the end leaves were infested before the fungicides were applied. In consequence of this a small proportion of these end leaves fell off, but most of the foliage on the end shoots was retained, and nearly all of it over the major part of the tree. In applying the fungicides it was planned to have 2 treated trees alternating with 2 untreated ones. This gave control trees equal in number to those treated, while treated and untreated trees were equally representative of the whole.

Two fungicides were used:

(1) Ammoniacal solution of copper carbonate. The treated trees in the west half of the line received this spray.

(2) Modified eau celeste. This was used for treatment of the trees in the east half of the line. These were mostly larger than those at the west.

These two fungicides were made as follows:

Ammoniacal copper carbonate.†—In a wooden pail 5 ounces of copper

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**Ibid.*, Vol. VII, No. 2, p. 69.

†When copper carbonate can not be had of dealers it may be made at home, and usually at less than the market cost. For directions for making see Journal of Mycology, Vol. VII, No. 2, pp. 77–78. Also Farmers' Bulletin No. 7, p. 12. The latter may be had from the Secretary of Agriculture.

carbonate was dissolved in 3 pints of concentrated ammonia (26°). This solution was diluted with 45 gallons of water.

Modified eau celeste (*new formula*).*—In 10 to 12 gallons of water 4 pounds of copper sulphate (crystals) were dissolved. To this solution was added 3 pints of concentrated ammonia (26°), and after stirring, this was diluted with water to 40 gallons. To this was added 6 to 8 gallons of water in which had previously been dissolved 5 pounds of sal-soda.

A cart sprayer holding about 50 gallons was used in these experiments, but for general field work a wagon tank similar to tanks in general use through southern California for the treatment of orange diseases, may be used. The pump should be of brass and kept well oiled, as the action of one of these sprays on metal is marked. The two lengths of spray hose should be about 24 feet long. To the free end of the hose was attached a piece of brass pipe 6 to 8 feet long and $\frac{5}{8}$ of an inch in diameter. This pipe is light, not easily affected by the fungicides as is the iron tubing, and is fitted with a stopcock so that the flow may be checked at any moment. To the end of the tube is fitted the Nixon nozzle. When applying the ammoniacal copper carbonate the No. 3 nozzle of this make works well; but it has been found that the brass netting used will not withstand the modified eau celeste. It is eaten through in a few moments and a suitable spray is no longer formed. The manufacturers have given assurance that they will have nozzles fitted with aluminium wire cloth the coming season, and this will probably withstand all mixtures suitable for fungicides.

It is very important that the mixtures be applied as a fine spray. When too coarse, the spray will collect in quantity on the leaves, and as a result they are burned. Further, there is a great loss of the fungicide when too coarse sprays are applied. Calm weather should always be selected for the treatment. In windy weather the trees will require nearly twice as much of the fungicide to properly reach all parts, and the work will not be done with the desired uniformity. With two length of hose 4 trees may be treated at each stand of the spray tank—2 on each side. All parts of the tree should be very thoroughly treated, both surfaces of the leaves as well as all of the branches. The light brass tube used is of great assistance in reaching the interior of the tree as well as the uppermost branches.

PLAN OF TREATMENT AND RECOMMENDATIONS.

The trees included in these experiments were numbered from west to east. Trees numbered 1, 2, 5, 6, 9, 10, 13, 14, 17, 18, and 19 were sprayed on April 15 with the ammoniacal solution of copper carbonate. Trees numbered 3, 4, 7, 8, 11, 12, 15, 16, 20, and 21 were left untreated.

* Differs from the ordinary modified eau celeste in the fact that ammonia is added before the sal soda.

The treated trees required about 2½ gallons of the fungicide at the time of the first treatment, as they were then in full leaf. When work was begun there was considerable wind blowing. Had it not been for this 2 gallons of spray would have done equally good work. The time required to spray was eight to ten minutes for each tree. In calm weather five to eight minutes would be sufficient for a tree in full leaf and four minutes for a tree not yet in leaf. The treated trees were carefully observed and it was not thought necessary to spray a second time until May 12. They were then treated with the same fungicide. This was the last treatment made, as the foliage retained the copper salts remarkably well and no heavy rains occurred later.

Trees numbered 22, 23, 26, 27, 30, 31, and 33 were first treated with the modified eau celeste on April 15. Trees numbered 24, 25, 28, 29, 32, and 34 were left untreated. The tops of the trees treated with this fungicide were, on the average, much larger than those treated with the ammoniacal copper carbonate. From 2½ to 3 gallons of fungicide would be required for such trees if the work be conducted in still weather and the spray be fine. In the present experiment there was considerable wind blowing, and the nozzles were imperfect because of the action of the sprays on the tip. Hence more fungicide was used than would otherwise have been required. About eight minutes were consumed in spraying each tree thoroughly.

After the first treatment there came a heavy rain. Nearly or quite 2 inches of water fell. Shortly afterward the trees were examined carefully, and it was found that the leaves were still well covered with the copper salts. A second thorough spraying was made with the same fungicide on May 12. From that time on the weather was dry, and the foliage and limbs of the treated trees retained the copper so perfectly that no other sprayings were necessary. As late as August 3 the mixture showed distinctly on all parts of the treated trees. It thus appears that modified eau celeste is an admirable spray to adhere, and in this dry climate, after the close of the winter rains, fewer treatments of plants are needed than in the East, where summer rains occur.

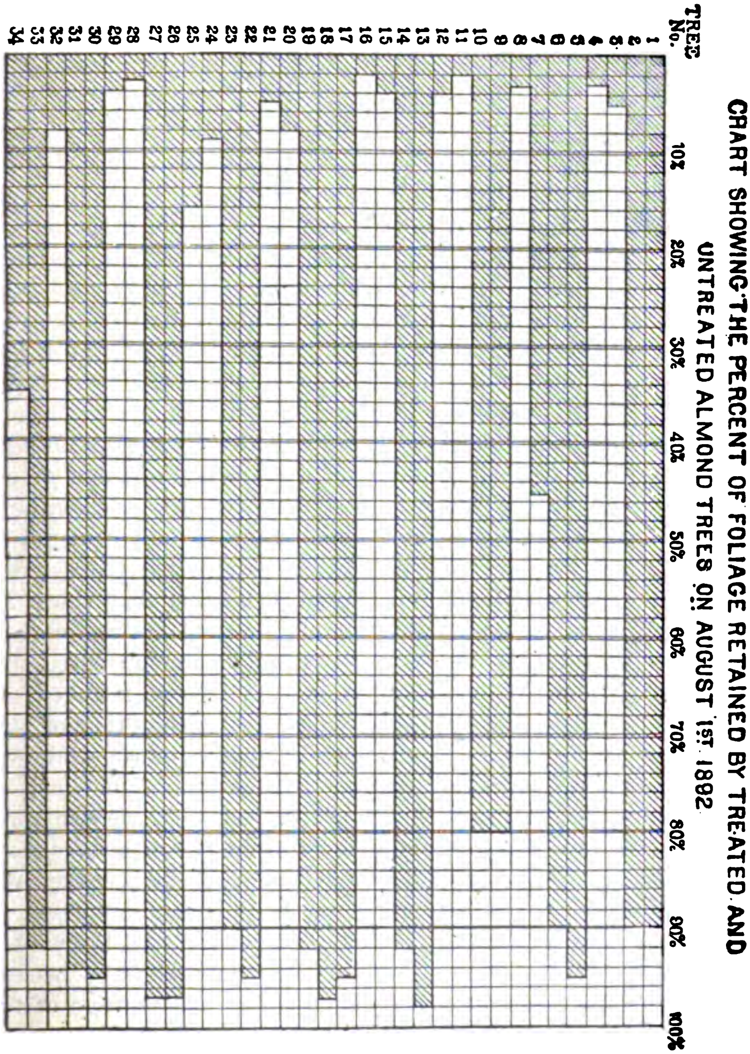
By June 14, the action of both the preceding sprays was evident. The leaves on untreated trees were becoming badly infested. The leaves on the outer twigs of the treated trees were also somewhat affected, but this was where infection had taken place from the branch previous to the first spraying. The main mass of foliage on nearly all treated trees was in excellent condition. On July 14 the results of the treatment were still more evident. The treated trees retained most of their foliage, while the untreated ones were rapidly becoming bare. Treated and untreated trees could be distinguished from a great distance. By August 1 the untreated trees were nearly bare, while the treated ones were yet in full leaf, with the exception of a few terminal twigs.

On August 3 an examination of the entire 34 trees was made and the percentage of the foliage remaining on all the trees was carefully estimated. The following table gives the results of this examination:

ABLE 1.—*Showing condition on August 3 of treated and untreated almond trees, sprayed with ammoniacal copper carbonate solution.*

No.	Treatment.	Per cent of foliage.	No.	Treatment.	Per cent of foliage.
1	Treated	90	12	Untreated	4
2	......do	90	13	Treated	98
3	Untreated	5	14	......do	92
4	......do	3	15	Untreated	4
5	Treated	95	16	......do	2
6	......do	90	17	Treated	95
7	Untreated	45	18	......do	97
8	......do	3	19	......do	92
9	Treated	80	20	Untreated	8
10	......do	80	21	......do	5
11	Untreated	2			

'he results are shown in a graphic form in the accompanying figure:



Here are shown the satisfactory results arising from the use of the ammoniacal solution of copper carbonate. The 11 sprayed trees retained from 80 to 98 per cent of the foliage, the average being 91 per cent. On the other hand, the 10 untreated trees, with one exception, had not retained more than 8 per cent of the foliage. The one exception, apparently a tree not badly infested by *Cercospora*, had still upon it about 45 per cent of its foliage. The foliage remaining on the 10 control trees averaged 8 per cent, but exclusive of the one exceptional tree it averaged only 4 per cent.

TABLE 2.—*Showing condition on August 3 of treated and untreated almond trees, sprayed with modified eau celeste, new formula.*

No.	Treatment.	Per cent of foliage.	No.	Treatment.	Per cent of foliage.
22	Treated	95	29	Untreated	4
23	......do	95	30	Treated	93
24	Untreated	8	31	......do	94
25	......do	14	32	Untreated	8
26	Treated	97	33	Treated	92
27	......do	97	34	Untreated	35
28	Untreated	3			

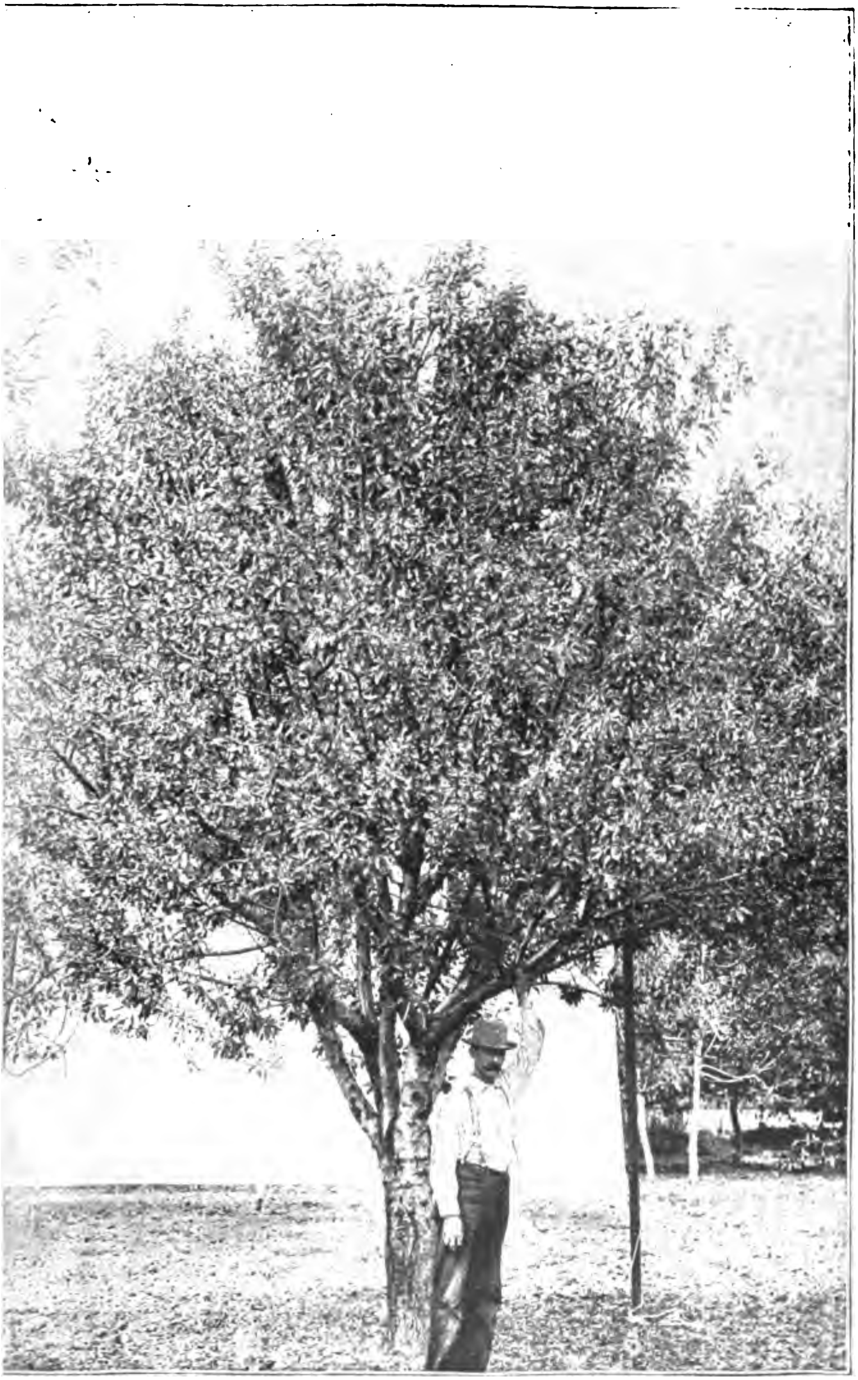
This table shows as good results from treatment with modified eau celeste as resulted from the use of ammoniacal copper carbonate. The 7 treated trees retained from 90 to 97 per cent of the foliage, the average being 94 per cent. The 6 untreated trees, with one exception, as in the former case, retained only from 3 to 14 per cent of their leaves. The exceptional tree in this case retained about 35 per cent of its foliage. Including this 1 tree, the average foliage on the untreated trees was 12 per cent, but exclusive of this tree it dropped to 7 per cent.

By comparing the trees treated with fungicides, we see that 91 per cent of foliage was preserved by the use of ammoniacal solution of copper carbonate, while 94 per cent was retained by using the modified eau celeste. This is so trifling a variation that it may be accounted for by the fact that the trees at the east, which were sprayed with eau celeste, are on better ground, are larger, and more healthy than those at the west, which were sprayed with the ammoniacal copper carbonate. These more favorable conditions show as well on the untreated trees as on the treated ones. The average amount of foliage retained on the untreated trees at the east was 3 per cent greater than that of the untreated trees at the west. This, curiously enough, is the difference in per cent of foliage on the treated trees at the east and on those at the west, which would seem to indicate that the action of the two sprays is almost exactly the same. If there exist any advantage of one spray over the other, so far as effectiveness as a fungicide is concerned, the advantages have not manifested themselves thus far.

Had the first treatment of these trees been made in the winter, as recommended below, the terminal leaves would not have become so generally infested by *Cercospora* and a higher percentage of foliage would have been retained. The method to follow is therefore evident.

Almond Tree. Treated with Ammoniacal Copper Carbonate. (Pierce)

ALMOND TREE. UNTREATED. (PIERCE.)



ALMOND TREE. TREATED WITH MODIFIED EAU CELESTE. (PIERCE.)

The first treatment should be given the naked trees, before they bloom. This treatment may be either with the modified eau celeste or the ammoniacal copper carbonate. Probably the last is preferable, as its presence is more easily detected, and it is well to be able to see if a sufficient deposit remains on the tree to prevent germination of spores at all times. This is especially necessary during the rainy season. The strength of this spray should be the same as that used in these experiments.

A second and third spray should be given the trees after they are in full leaf. The second shortly after the leaves are well developed and the third about a month later or after the spring rains have ceased. In making these sprays there may be added 10 to 15 per cent more water than was used in the experiments. Observations made on the treated trees lead to the conclusion that this reduction in strength would not detract to a serious extent from the fungicidal qualities of the sprays. It should always be borne in mind, however, that the treatment must be thorough to be effective. In case rains remove the copper salts after the third treatment another spraying should follow.

The cost of treating trees will vary greatly, according to the prices paid for chemicals and labor. Where large quantities of chemicals are purchased the prices should range about as follows:

	Per pound.
Ammonia (26°)	\$0.08
Sal soda	0.02
Copper sulphate, crystals	0.06
Copper carbonate	0.40

At the above prices the ammoniacal copper carbonate required for treating a medium-sized tree three times, in all 6 to 7 gallons, will be close to 5 or 6 cents. The same amounts of the modified eau celeste will cost, at these prices, from 7 to 9 cents. As before stated, when the carbonate of copper can be made at home the cost is reduced, sometimes as low as 18 to 20 cents per pound. With proper facilities, the time required to spray a large almond tree in full leaf, in calm weather, should not exceed eight minutes, and four minutes should do the work on naked trees. This would give twenty minutes for three treatments in the season. Even this is probably allowing more time than would be given in general work.

DESCRIPTION OF PLATES.

PLATE XVIII. Tree No. 18 treated with ammoniacal copper carbonate solution. Amount of foliage retained estimated at 97 per cent. From photograph taken August 3, 1892.

PLATE XIX. Tree No. 16 untreated. Estimated to have retained only 2 per cent of its foliage. From a photograph taken August 3, 1892.

PLATE XX. Tree No. 27 treated with modified eau celeste. Calculated to have retained 97 per cent of its foliage. From a photograph taken August 3, 1892.

EXPERIMENTS IN PREVENTING LEAF DISEASES OF NURSERY STOCK IN WESTERN NEW YORK.

By D. G. Fairchild.

[Plates XXI-XXIX.]

It is the intention to give in the following paper a brief account of experiments made during the seasons of 1891 and 1892 with a view of preventing the various leaf diseases of nursery stock. These experiments were carried on at Geneva, N. Y., one of the largest nursery centers east of the Mississippi. The kindness of Dr. Collier, director of the New York State Agricultural Experiment Station, made it possible for the work to be done upon the station grounds, whose proximity to the laboratories and assistance from the station staff greatly facilitated the work.

To bring together in one article the results of the experiments, it will be necessary to repeat in part matter that has previously been published.*

The original object of the experiments conducted at Geneva was to throw light upon the following questions:

(1) Can the leaf-blight of pear, cherry, plum, and quince stocks and the powdery mildew of the apple be prevented by the use of Bordeaux mixture or ammoniacal solution of copper carbonate?

(2) What effect is produced upon the growth of nursery stock, budded and not budded, by repeated treatments with Bordeaux mixture and ammoniacal solution?

(3) What effect, if any, has the variety of stock upon the scion or "bud" with respect to its resistance to leaf-blight?

While the experiments have thrown considerable light upon the first and second questions, the nursery was not extensive enough nor the soil uniform† enough to admit of any but general conclusions being drawn as to the third question. Further, the experiment was begun so late in the season that it was not possible to secure stocks of uniform size, and it is doubtful if any experiments, unless made upon uniform soil, with stocks grown from cuttings, will settle in a satisfactory manner a phase of this problem in which there are so many variable factors.

The various leaf diseases will now be discussed, together with the results of the experiments made for preventing them. The numerous

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*Annual Report of the Secretary of Agriculture for 1891, p. 368. Bull. No. 3, Div. of Veg. Pathology, pp. 57–60. Tenth Ann. Report N. Y. Agrl. Expt. Sta., 1892, pp 179–181.

† As the experiments progressed it was plainly evident that a strip 30 feet or so wide, at the west end of the block, had at some previous time received fertilizers, which rendered it eminently suited to the needs of pear stocks. As no accurate record of this portion of the farm seems to have been kept, it was impossible to ascertain what fertilizers had been used upon the strip.

details, of interest only to those who are pursuing similar studies, are given in small type at the close of the article.

PEAR LEAF-BLIGHT (*Entomosporium maculatum* Lév.).

This disease is perhaps the greatest obstacle to the profitable production of pear stocks. The principal injury is caused by a premature defoliation of the seedlings. When such defoliation takes place early in the season, as is quite commonly the case, the young seedlings are forced to form a new set of leaves, presumably at great expense to the reserve material stored for use the coming spring. Often this formation of new leaves is repeated two or three times, the seedling finally becoming too exhausted to continue the struggle. If the following winter be survived, enough growth may be made to render budding possible.

Although the disease is very abundant on bearing trees further south, it seems to be confined in western New York, at least in its severe attacks, to one, two, and three year old seedlings, occasionally defoliating a budded stock of some susceptible variety like the Flemish Beauty. All ordinary budded stocks are commonly immune from the disease, although the stocks into which the buds are inserted may have been diseased before being budded.* So far as the author's observations go the fungus causing the disease does not attack the seeds of the pear or the cotyledons of the young seedlings until two weeks after the appearance of the latter above the surface of the soil. Early in the season it attacks only the foliage, but later, as the defoliation continues, it is found on the succulent growing tip of the stem. For 3 or 4 inches from the terminal bud the bark is covered with small, sunken spots, bearing in their centers the mature fruiting bodies of the fungus, this condition first becoming noticeable about the middle of August. As first pointed out by Sorauer,† it is in these sunken spots that the parasite passes the winter. In America the parasite lives from year to year, as it does in Germany, upon the bark of the growing seedling and infects the young leaves upon their first appearance in the spring. On May 20, before the foliage of last season's unbudded stocks was two-thirds grown, mature pustules were found upon the young leaves in immediate proximity to these spots upon the twigs. A microscopic examination of the spots revealed the parasite in an active condition. There is little doubt that the infected twigs

* The terms "seedlings" and "stocks" are here employed as in common use among nurserymen. A seedling in nursery parlance means a plant grown from seed before it is transplanted into the nursery row, while the term stock is used to designate the seedling after transplanting either before or after budding. Whenever I have referred to stocks which have been budded I have used the terms "budded stocks" or "buds."

† *Sorauer, P.* Handb. d. Pflanzenkrankheiten. Zweite Aufl., 1886, vol. II, p. 373. Monatschr. d. Ver. zur Beförd. d. Gartenb. Kgl. preuss. St., Jan. 1878. (Cited by Frank, Krankh. d. Pfl., 1880, p. 590.)

are the principal means by which the fungus is carried through the winter and the presence of an ascigerous form, described by Sorauer, seems almost unnecessary to a maintenance of the disease in a region once infested.

The practice of allowing stocks to remain in the nursery rows when leaf-blight has affected them so severely as to render them unbuddable, seems unwise when considered from a hygienic standpoint. Such stocks are almost sure to harbor the parasite in its winter form upon their slender branches, which are lacking in vigor. It is from these stocks that the disease apparently spreads to other plantings of seedlings in the vicinity and to such budded stocks as are susceptible. It would seem advisable, therefore, that when leaf-blight causes a large number of failures in the seed bed, the diseased seedlings should be headed back to within 1 or 2 inches of the ground and all side shoots likely to harbor the parasite removed. Such procedure would undoubtedly decrease the liability to so early an attack of the disease and enable growth to be made before the malady had time to spread from infected localities. The same immunity as that shown by rapidly growing "buds" may prove here a valuable factor. It has been objected, however, that the simultaneous appearance of several shoots from the headed back seedling would prevent, or at least materially hinder the budders in their work the following fall. This obstacle could be overcome by the early removal of all but one shoot. It seems to me that this method of eradicating the disease is sufficiently promising to warrant a thorough test. The matter of protecting seedlings by wind-breaks has not been thoroughly tested to my knowledge, and from observation on the spread of the disease I am inclined to believe it is worthy a systematic trial. The freedom from leaf-blight, which isolated blocks of pear seedlings often show, tends to confirm the observation that the malady travels quite slowly from seedling to seedling. In an experimental block of seedlings mentioned below it required nearly two months for the disease to travel from the east to the west end, a distance of 150 feet.

Two quite distinct experiments were made with a view of preventing this disease, one inaugurated in 1891 to test the effect of fungicides upon stocks, and the other carried on during the season of 1892 with seedlings in the seed bed. The results of only the former experiments are recorded here and an account of the latter is reserved for future publication.

EXPERIMENTS WITH STOCKS.

These experiments were inaugurated in the spring of 1891 and continued until the fall of 1892. The stocks planted in 1891 were sprayed both seasons, the design being to ascertain the effects of two consecutive years. The results are here presented briefly and the minor details are to be found at the close of the article.

All the stocks were sprayed on the same dates; in 1891 on May 21, June 3 and 24, July 9 and 24, and August 8 and 28. One-half the stocks were treated seven times, on the dates just indicated, and one-half only three times, on the first three dates named. In 1892 the dates of treatment were May 26–27, June 15–16, June 23, July 6–7 and 21, and August 5. One-half were sprayed five times, on the first five dates mentioned, the other half six times as just indicated. The only fungicides used were Bordeaux mixture and ammoniacal solution. In 1891 both preparations were of essentially standard strength, but in 1892 the Bordeaux mixture was reduced to the 60-gallon formula, as explained on a subsequent page (p. 262).

FRENCH PEAR STOCKS.

1891.—Four rows (1,922 stocks), of which 1,462 were treated and 460 left untreated. One-half the treated stocks were sprayed with ammoniacal solution, the other half with Bordeaux, at the dates above indicated. Although the disease was not so abundant in 1891 as in 1892, the contrast between treated and untreated was striking. Seven treatments with Bordeaux proved efficacious, while neither three treatments with Bordeaux nor seven with ammoniacal solution showed as good results, and three treatments with ammoniacal solution were without apparent effect. On October 9 a count of those stocks forced by the premature fall of the foliage to put forth new leaves gave the following figures:

TABLE 1.—*Showing number of French stocks forced to put out new leaves.*

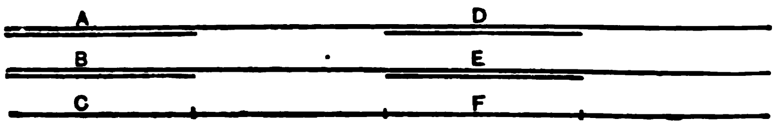
Number and treatment of stocks.	Total re-leaved.	Per cent re-leaved.
388 stocks treated 7 times with Bordeaux	4	1.0
356 stocks treated 3 times with Bordeaux	55	16.4
361 stocks treated 7 times with ammoniacal solution	50	13.8
357 stocks treated 3 times with ammoniacal solution	161	45.0
460 stocks untreated	97	21.0

1892.—The same rows of stocks as were employed in 1891 were treated in 1892, but one-half of them had been budded the fall previous, as subsequently described on pp. 258, 261. The other half was purposely left unbudded to furnish a means of testing the fungicides. The treatments were made on dates given above, using the formulæ mentioned on p. 262. During the course of the season little difference between treated and untreated budded stocks was noticeable, as none but the Flemish Beauty were subject to the disease. At the close of the season, however, the foliage on treated Flemish Beauty was much superior to that on untreated. Bordeaux proved superior to ammoniacal solution and entirely efficacious.

The greatest contrast in the experiment was between the treated and untreated stocks which had not been budded. The susceptibility of these unbudded seedlings afforded an excellent opportunity to test the

efficacy of the fungicides, and the results fully warrant the extended use of Bordeaux mixture upon such stocks. As early as June 2 the difference between treated and untreated sections was visible, per cent of the foliage of the untreated being diseased, while the sections sprayed with Bordeaux mixture remained healthy. Plates XXI and XXII show fairly well the contrast as it appeared on October 1, the two rows standing only 3½ feet apart. The difference consisted not only in the presence of foliage on the treated and its absence on the untreated, but in an increased growth of the former, as is shown by weights and measurements of the stocks given below. A calipering of these stocks in 1891 showed no appreciable average difference in diameter.

DIAGRAM 1.—*Showing arrangement of treated and untreated rows.*



EXPLANATION OF DIAGRAM 1.

A and B, treated 7 times in 1891 and 6 times in 1892 with Bordeaux; C, control on row opposite; D and E, treated three times in 1891 and 5 times in 1892 with Bordeaux; F, control on row opposite. This portion of the experiment was situated on rows VI, VII, and VIII, as indicated in Table 2, below, and in the plan on p. 257. The unbudded portion alone is considered.

TABLE 2.—*Showing weights and measurements of treated and untreated French pear stocks in November.*

Row.	Section.	Diagram designation.	Treatment.	No. of seedlings.	Average weight as dug.	Average weight of top.	Average diameter at collar, in thirty-seconds of an inch.
					Ounces.	*Ounces.*	
VIII	Bb 2	A	Bordeaux, 7 times in 1891, 6 times in 1892	57	7.6	6.4	22.0
VII	Cb 2	B	......do	61	8.8	6.8	27.5
VI	D 6	C	Untreated in 1891 and 1892.	57	5.9	4.0	17.6
VIII	Bb 1	D	Bordeaux, 3 times in 1891, 5 times in 1892	63	9.1	7.1	23.1
VII	Cb 1	E	......do	63	7.8	5.7	22.0
VI	Db	F	Untreated in 1891 and 1892.	57	5.9	4.0	17.6

The above data were secured in the following manner: The first week in November each individual stock was dug carefully and the dirt cleaned from the roots. It was then calipered and weighed. The top was then cut off and weighed separately. These data are, perhaps, the first published showing the superiority of treated pear seedlings in other respects than that of foliage. As regards a comparison of the two copper compounds, it will be sufficient to say that the Bordeaux was in all respects superior to the ammoniacal solution. In the order of their efficacy the four methods of treatment are as follows: Bordeaux,

6 treatments; Bordeaux, 5 treatments; ammoniacal solution, 6 treatments; ammoniacal solution, 5 treatments. Five treatments with the ammoniacal solution proved almost entirely ineffectual. Plate XXIII shows the average of stocks treated 6 times with ammoniacal solution.

JAPAN PEAR STOCKS.

1891.—One row of 466 stocks was planted in a manner precisely similar to that described for the French stocks. The dates of treatment were as above given, one-half the treated portion receiving three treatments and the other seven, one-half being treated with Bordeaux, the other with ammoniacal solution. The results obtained were striking, as illustrated by the following notes on the *re-leaved* stocks:

TABLE 3.—*Showing number of Japan stocks forced to put out new leaves.*

Number and treatment of stocks.	Total No. re-leaved.	Per cent re-leaved.
87 stocks treated 7 times with Bordeaux	1	1.1
88 stocks treated 3 times with Bordeaux	21	23.8
87 stocks treated 7 times with ammoniacal solution	15	17.2
90 stocks treated 3 times with ammoniacal solution	9	10.0
114 stocks untreated	47	41.2

The average diameter of the stocks near the collar was not perceptibly greater in the treated than in the untreated, the average difference amounting to less than one thirty-second of an inch. The untreated Japan stocks suffered more from the disease than the untreated French stocks.

1892.—The same row of stocks as that employed the previous season was treated, but one-half or more of the stocks were budded in 1891, as described subsequently on pp. 259, 261. The treatments given were as described on pp. 262–263. As early as June 24 the unbudded stocks, which had not been treated, showed the disease plainly, every stock being affected. At this date it was evident that the Japan stocks, as introduced from the south, were more susceptible to leaf-blight than the imported French or the native-grown American stocks. The latter were at this date scarcely affected by the disease. From the two years' experiments upon Japan stocks from Franklin Davis & Co.'s nurseries it seems probable that these when imported from the South will not show any greater immunity from leaf-blight than the French or American stocks. A more extended experiment, however, is needed to settle this point. The result of treatments with fungicides was as striking as that gained from the French stocks. The foliage on the budded stocks remained reasonably free from the disease until quite late in September when the stocks in the untreated portions began to drop their leaves badly; those treated 6 times with Bordeaux held their leaves almost intact. The Bordeaux proved in general more efficacious than the ammoniacal solution in the treatment of both budded and unbudded stocks,

and 6 treatments were more effective than 5. But one noteworthy exception existed in the first section treated 5 times with ammoniacal solution, which is possibly explainable by superiority of soil.

Below are given in Table 4 the notes on foliage and caliper made October 19, 1892:

TABLE 4.—*Showing condition of Japan stocks as regards foliage and caliper.*

Section.*	Treatment.	Estimated per cent of foliage dropped.		Average caliper of unbudded at collar in $\frac{1}{32}$ of inch.
		Budded stocks.	Unbudded stocks.	
Aa1	Ammoniacal solution, 5 treatments	0	0	26.6
Ba1	Do	0	80	13.4
Ca1	Do	80	80	15.0
Aa2	Ammonical solution, 6 treatments	0	50	23.3
Ba2	Do	0	15	24.7
Ca2	Do	85	60	21.6
Ab1	Bordeaux mixture 5 treatments	0	10	18.7
Bb1	Do	0	25	19.7
Cb1	Do	40	50	21.3
Ab2	Bordeaux mixture, 6 treatments	0	5	21.5
Bb2	Do	0	10	18.5
Cb2	Do	0	0	23.1
D-I	Untreated (budded)	15	....	....
D-II	Do	40	....	....
D-III	Do	95	....	....
D-IV	Untreated (not budded)	....	98	13.2

* Designations in this column refer to the varieties of "buds," for details of which, see p. 261.

It is noticeable from the above table that Bordeaux mixture afforded the greatest immunity; also that the untreated unbudded stocks made much less growth than those treated with Bordeaux. A reference to the plan (p. 257) will show the situation of the row (No. IX). When it is remembered that of all of the French stocks, those standing in row VIII only $3\frac{1}{2}$ feet distant, made the best growth, the element of soil difference is hardly to be considered as a disturbing factor.

AMERICAN PEAR STOCKS.

1891.—Four rows containing 1,673 stocks were subjected to a course of treatment similar in every respect to that given the French and Japan stocks. Owing to the lateness of the season when application was made to the growers of American seedlings only second-grade stocks were to be obtained. Because of this unfortunate but unavoidable circumstance no comparison could be drawn as to the comparative value of American, Japan, and imported French stocks. The results of the treatments with fungicides while not as striking as with the French stocks, are valuable as adding testimony to the efficacy of the Bordeaux.* Seven treatments with this mixture proved entirely efficacious, raising the percentage of stocks wholly free from the disease from two-tenths of 1 per cent to 39 per cent. On October 9 a count was made of the

* See Bull. No. 3 Div. Veg. Path., p. 59.

umber of stocks in each section which pushed out new leaves because f the severity of leaf-blight. The results of this count are as follows:

TABLE 5.—*Showing number of American stocks forced to put out new leaves.*

Number and treatment of stocks.	Total number re-leaved.	Per cent re-leaved.
326 stocks treated 7 times with Bordeaux	7	2.14
288 stocks treated 3 times with Bordeaux	93	32.29
313 stocks treated 7 times with ammoniacal solution	51	16.29
325 stocks treated 3 times with ammoniacal solution	94	28.92
421 stocks untreated	152	36.10

1892.—The same rows of stocks were employed this season as had een treated the previous season, as many as possible of them having een budded as described subsequently on p. 261. Those not budable were left standing for further treatment with fungicides. The treatments were as described on pp. 262–263. Owing to the inferior character of the stocks originally planted this whole block would be considered worthless, as not one-half the stocks were budable in 1891. The effect of the Bordeaux mixture, however, was plainly observable and a rough estimate made October 19 of the percentage of foliage still upon the unbudded stocks shows the Bordeaux to be much superior to the ammoniacal solution, and 6 treatments superior to 5.

QUINCE LEAF-BLIGHT (*Entomosporium maculatum* Lév.).

Much that was said in reference to pear leaf-blight applies equally well to quince leaf-blight, which is caused by the attacks of the same fungus. The parasite, so far as the author's observation goes, never attacks the bark on the young shoots but is confined wholly to the foliage. The Angers quince seems more susceptible than the Orange and it is rare to observe after the first week in September a block of quince cuttings from which at least 50 per cent of the leaves have not fallen. Unlike the disease on the pear, the quince leaf-blight often seriously defoliates bearing trees in this section and commonly causes the fruit-grower much loss from its attacks on the ripening fruits, in which form it is called "fruit spot."*

The experiments in the prevention of this disease were confined to one row of Angers quince cuttings, treated partly with Bordeaux mixture and partly with ammoniacal solution.†

ANGERS QUINCE STOCKS.

1891.—One row of 509 cuttings was planted and treated with fungicides in the manner described on pp. 260–263. The season being an unusually dry one, no disease of any consequence appeared, and as

* Bull. 3 Div. Veg. Path., pp. 65–68, Pl. VII, VIII.

† For formulæ of fungicides and dates of treatment, see pp. 262–263.

stated in a previous publication* the insignificant quantity of leaf blight present offered no opportunity to test the fungicides in a satisfactory manner.

1892.—The same row of cuttings as employed in 1891 was treated this season, but one-half or more of each section had been budded the fall previous, as noted below, p. 260. The treatments were identical with those made upon the pear stock; see p. 262. As early as July 7 the leaves on the untreated section left without budding showed the disease plainly, while the foliage of those sections treated with Bordeaux and ammoniacal solution remained free from the disease. By August 30 two-thirds of the foliage of the unbudded, untreated portion had fallen to the ground, while the treated sections standing in the same row, as shown in the plan, p. 257, row V, remained intact. Plates XXIV and XXV show the appearance of the treated and untreated sections.

On September 29 the difference manifested by these stocks was not one of foliage only. The twigs of the treated, upon close examination, were apparently a trifle more robust, and the caliper of the cuttings at the base showed a considerable increase not to be attributed to differences in soil. Below are given the data secured from a careful calipering of the *unbudded* stocks at the collar, made October 15. The figures given are in thirty-seconds of an inch and represent the average diameter of stocks in each section:

TABLE 6.—*Showing average caliper of treated and untreated unbudded quince stocks.*

Section.	Number and treatment of stocks.	Average diameter.
Aa1	16 stocks treated 5 times with ammoniacal solution	25.3
Ba1	16 stocks treated 5 times with ammoniacal solution	26.2
Ca1	16 stocks treated 5 times with ammoniacal solution	26.3
Aa2	15 stocks treated 6 times with ammoniacal solution	25.0
Ba2	16 stocks treated 6 times with ammoniacal solution	27.0
Ca2	15 stocks treated 6 times with ammoniacal solution	24.0
Ab1	15 stocks treated 5 times with Bordeaux mixture	27.0
Bb1	16 stocks treated 5 times with Bordeaux mixture	25.2
Cb1	16 stocks treated 5 times with Bordeaux mixture	25.2
Ab2	17 stocks treated 6 times with Bordeaux mixture	29.2
Bb2	17 stocks treated 6 times with Bordeaux mixture	26.4
*Div	90 stocks untreated	20.6

*Unfortunately a section, Cb2, was not staked off in planning the experiment.

The inference from the above table is that the stocks which held their leaves through the season made a greater growth in diameter than those from which the foliage dropped in July and August. Taking the average of all stocks treated with ammoniacal solution, 94 in number, we have 25.7 thirty-seconds of an inch, while the average of 81 stocks treated with Bordeaux was 26.5 thirty-seconds. The better of these two averages (26.5) when compared with the untreated (20.6) gives an increase in diameter of 5.9 thirty-seconds or nearly three-sixteenths of an inch.

* Bull. No. 3, op. cit., pp. 58-59.

CHERRY LEAF-BLIGHT (*Cylindrosporium padi* Karsten).

The leaf-blight of cherries caused by the same species of fungus as that producing plum leaf-blight, is very widespread. Scarcely a wild species of the genus *Prunus* is entirely exempt from the disease, and at all stages from seedlings in the seed bed to old bearing trees, cultivated cherries are subject to its attacks. The greatest variation exists, however, as regards the susceptibility of different varieties, some being nearly exempt and others, as the English Morello, materially damaged by it. Remarkable cases of immunity are sometimes observed. Of seedlings used for budding, only the Mazzard seems in any serious degree damaged by the disease. In unfavorable years the defoliation is so serious as to render the first year's growth of stocks almost insignificant. Mazzard seedlings of the second year are also badly attacked. The greatest damage probably occurs where Mazzard stocks are budded with susceptible varieties, in which case the cumulative effects of the disease appear. It should be noted here, however, that the cherry leaves attacked by the parasite remain attached to the stocks long enough to take on the yellow autumn tints characteristic of foliage from which the valuable ingredients of potash and phosphoric acid have been removed.* It is probable, although no experiments have to my knowledge been made to establish it, that the premature fall of the leaves does not entail so great a loss to the cherry seedling as does the fall of the pear foliage, which drops while still green.

The experiments in the prevention of this disease, extending over a period of two seasons, were made upon the two well-known kinds of stocks, Mahaleb and Mazzard. In 1891 only the stocks not yet budded were treated, while in 1892 the stocks budded in the fall of 1891 were sprayed, suitable control being left.

For record of budding see pp. 258, 260. Bordeaux mixture and ammoniacal solution of standard strength were employed in 1891; ammoniacal solution of standard strength and Bordeaux of one-third strength in 1892.†

MAHALEB CHERRY STOCKS.

1891.—One row of 449 stocks was planted and treated with fungicides at the dates described for all the stocks on p. 263. One-half, excepting controls, received 6 and the other 3 sprayings. One-half were treated with ammoniacal solution, the other with Bordeaux. As mentioned in Bulletin No. 3,‡ where an account of this experiment has already been

*According to the prevailing views of the physiological botanists, Pfeffer, Sachs, Detmer, Wiesner, and others, the valuable mineral constituents of leaves are withdrawn from them at the same time as they become yellow and before they fall to the ground; but the recent paper of Wehmer, *Die dem Laubfall voraufgehende vermeintliche Blattentleerung.* <*Ber. d. deutsch. bot. Gesellsch. 10 Jahrg., Heft. 3, pp. 152–163,* indicates that the grounds for this belief may not have been sufficiently proven, and the whole subject needs further investigation.

† See p. 262 for formulæ of all fungicides used.

‡ Op. cit., p. 53.

given, the leaf-blight was not present in any considerable amount during the season and the efficacy of the two fungicides was not given a test of any severity. The treated portions, however, remained freer from disease than the untreated.

1892.—The same row which had been budded in the fall of 1891 as described subsequently, was treated this season in a manner precisely similar to that described for the pear stocks on page 263. Care was taken that the undersides of the leaves were wet by the spray and to accomplish this the Vermorel nozzle was directed upwards. On June 24 the first signs of leaf-blight were noticed upon the budded, untreated. stocks, the unbudded stocks remaining almost entirely free throughout the season. By July 16 the leaves of the untreated began to fall and continued dropping until many of the stocks were left nearly leafless. On October 4 a careful count was made of the number of leaves which had fallen from each individual stock in the row. This was accomplished, in a comparative way, by counting the leaf-scars on each stock. Below is given for convenience a condensed statement of the condition of the stocks with regard to height, diameter 3 inches above the union, and freedom from leaf-blight. All numbers represent averages. Height above ground (measured September 28) is represented in feet and inches, while the figures for diameter (measured October 15) are in thirty-seconds of an inch. Only budded stocks are here taken into account.

TABLE 7.—*Showing condition of budded Mahaleb stocks, treated and untreated, as regards foliage and measurements.*

Section.	Numbers, kinds, and treatment of stocks.	Average number of leaves fallen October 4.	Average height above ground.		Average caliper 3 inches above union.
			Feet.	*Inches.*	
Aa 1	16 budded Windsor stocks. Ammoniacal, 5 treatments	8.0	5	8	23
Aa 2	18 budded Windsor stocks. Ammoniacal, 6 treatments	7.8	5	10	23
Ab 1	13 budded Windsor stocks. Bordeaux, 5 treatments	13.1	6	0	24
Ab 2	17 budded Windsor stocks. Bordeaux, 6 treatments	7.4	6	0	25
D-III	7 budded Windsor stocks. Untreated	54.8	5	0	16
Ba 1	18 budded Yellow Spanish stocks. Ammoniacal, 5 treatments	6.4	4	9	22
Ba 2	17 budded Yellow Spanish stocks. Ammoniacal, 6 treatments	6.4	4	9	21
Bb 1	18 budded Yellow Spanish stocks. Bordeaux, 5 treatments	7.3	5	4	21
Bb 2	18 budded Yellow Spanish stocks, Bordeaux, 6 treatments	4.8	5	1	23
D-II	8 budded Yellow Spanish stocks. Untreated	21.3	4	1	16
Ca 1	16 budded Montmorency stocks. Ammoniacal, 5 treatments	8.5	3	7	21
Ca 2	18 budded Montmorency stocks. Ammoniacal, 6 treatments	10.3	3	5	21
Cb 1	22 budded Montmorency stocks. Bordeaux, 5 treatments	4.0	3	5	21
Cb 2	16 budded Montmorency stocks. Bordeaux, 6 treatments	6.1	3	9	19
D-I	4 budded Montmorency stocks. Untreated	65.7	3	6	17

The conclusion which can be drawn from the table seems to be that the treated sections held their leaves better, made as good a growth in height, and without exception a greater growth in diameter, or "caliper," than the untreated sections. That this increased growth was due entirely to the fungicide it will not be possible to maintain, for this difference may possibly have been brought about in part or wholly by variations in the soil. That none of the mixtures injured the "buds" it is believed is clearly shown.

The answer to question 3, as to the effect of fungicides on the growth of budded stocks is here, for the Bordeaux mixture at least, satisfactorily found, for both Windsor and Yellow Spanish stocks did better under treatment with Bordeaux than without treatment. There still remains a doubt as to the beneficial effect of ammoniacal solution. In all cases where used it was apparently slightly injurious to the foliage. The leaves assumed a yellowish unhealthy appearance. Plates XXVI and XXVII show the comparison between treated and untreated "buds."

MAZZARD CHERRY STOCKS.

1891.—One row of 468 stocks was experimented with, receiving as nearly as possible a course of treatment identical with that given the Mahaleb stocks. During the season, as in the case of the Mahalebs, only an insignificant amount of leaf-blight was present, affording no opportunity to test the fungicides. The powdery mildew (*Podosphæra oxyacanthæ* (DC.) Winter ?) made its appearance in small amount on the stocks in August and offered an opportunity to observe the beneficial effects of Bordeaux mixture in the treatment of this disease. Seven treatments with Bordeaux materially decreased the amount of the disease and proved superior to seven treatments with ammoniacal solution.* Three early treatments with either fungicide had no preventive effect.

1892.—The same row as that treated in 1891 was used this season, but budded with three different varieties identical with those budded on the Mahaleb stocks as shown in the table on p. 260. The treatments were similar in all respects to those given the Mahaleb stocks. The condition of the stocks at the close of the season is shown by the following table:

*See Bull. No. 3 Div. Veg. Path., 1892, p. 58.

Table 8.—*Showing condition of budded Mazzard stocks treated and untreated as regards foliage and measurements.*

Section.	Number, kinds, and treatment of stocks.	Average number of leaves fallen Oct. 10.	Average height above ground.		Average caliper 3 inches above union.
			Feet.	*Inches.*	
Aa 1	25 budded Windsor stocks; ammoniacal, 5 treatments	5.0	4	10	16
Aa 2	30 budded Windsor stocks; ammoniacal, 6 treatments	5.3	5	6	20
Ab 1	27 budded Windsor stocks; Bordeaux, 5 treatments	6.4	5	9	20
Ab 2	27 budded Windsor stocks; Bordeaux, 6 treatments	5.3	5	10	20
D-I*	11 budded Windsor stocks; untreated	18.7	4	9	20
Ba 1	27 budded Yellow Spanish stocks; ammoniacal, 5 treatments	4.2	4	5	19
Ba 2	28 budded Yellow Spanish stocks; ammoniacal, 6 treatments	4.6	4	10	21
Bb 1	31 budded Yellow Spanish stocks; Bordeaux, 5 treatments	2.9	5	6	18
Bb 2	31 budded Yellow Spanish stocks; Bordeaux, 6 treatments	2.5	4	5	18
D-II	14 budded Yellow Spanish stocks; untreated	8.7	3	2	15
Ca 1	26 budded Montmorency stocks; ammoniacal, 5 treatments	6.3	3	7	18
Ca 2	18 budded Montmorency stocks; ammoniacal, 6 treatments	6.8	3	3	17
Cb 1	26 budded Montmorency stocks; Bordeaux, 5 treatments	5.9	3	1	17
Cb 2	26 budded Montmorency stocks; Bordeaux, 6 treatments	5.0	3	1	17
D-III	7 budded Montmorency stocks; untreated	24.2	2	8	14

* By an accident this section received one late spraying with Bordeaux and hence it is rendered unfit for comparison.

The disease did comparatively little damage upon these stocks, but as shown by the table, the treated sections were superior to the untreated, and the Bordeaux slightly superior to the ammoniacal solution when 6 treatments are compared.* The difference between 5 and 6 treatments was not very marked.

A comparison of the two tables brings out the fact which is noteworthy in this connection, that the "buds"† on Mahaleb stocks averaged greater in diameter throughout than those on the Mazzard. This difference is constant when stocks receiving the same treatment are compared in each row, with the exception of the untreated section of Windsors when compared with that treated once by mistake. This constant difference in diameter, at 3 inches above the base ("caliper"), is of such importance as to merit further observations. The author regrets that the control rows were left so small, and feels warranted in drawing only the general conclusion, which was strikingly demonstrated that the fungicides were effective to a remarkable degree in preventing the disease and that treated stocks made the best growth.

* The superiority of Bordeaux is not fully shown by the figures, as in every case the effect of the ammoniacal solution was evidently injurious to the health of the foliage.

† The term "bud" is here used, as among nurserymen, to indicate a budded stock after the top has been cut off and the inserted bud itself allowed to grow.

PLUM LEAF-BLIGHT (*Cylindrosporium padi* Karsten.)

The plum leaf-blight in western New York, aside from giving much rouble to nurserymen, does very great damage to many varieties of earing trees, defoliating them in August and September. This disease s considered by the plum-growers in the vicinity of Geneva as their nost persistent enemy. A large orchard belonging to E. Smith & Sons, miles northwest of the city, was, they informed me, winter-killed bout thirty years ago because of defoliation the summer previous. It s a common opinion among orchardists that leaf-blight, through its etarding effect upon the maturation of the wood, renders the trees ncapable of withstanding the changes in temperature of a trying winer. Whatever the explanation of this fact may be, it seems self-evilent that a tree which drops its leaves before the normal season sufers very material loss.

Of nursery stocks, the native-grown seedlings suffer the most from this disease, often losing all their leaves by the middle of August. Myrobolan and Marianna stocks are not to any extent subject the first season. In entire contradistinction to the immunity exhibited by pear "buds" which resist to a remarkable degree pear leaf-blight, the budded plum stocks are particularly susceptible to plum leaf-blight. Apparently the same conditions of rapid growth which afford immunity in the one case tend to susceptibility in the other. The two instances offer a fertile field for inquiry.

The experiments on this disease were made with Bordeaux mixture and ammoniacal solution upon two rows of stocks, one of Marianna, containing 504 stocks, and the other of Myrobolan, containing 474 stocks. As described previously* the results of the first season's experiment were entirely negative, as the disease failed to appear.

On October 9 the three varieties, Early Prolific (Early Rivers), Purple Egg (Hudson River Purple Egg), and Italian Prune (Fellenburg), were budded upon both rows of stocks as set forth subsequently, p. 258. Numerous stocks were left unbudded to test the effect of the fungicides and the end of each row was left untreated.

The rows were treated in 1892 with Bordeaux and ammoniacal solution, the formulæ of which are described on p. 262. One-half the treated stocks received 5 sprayings and the other 6, at the dates given on p. 243. In all respects the two rows were treated alike.

MYROBOLAN STOCKS.

1892.—The disease made its first appearance in June upon the unbudded stocks which were carried over from 1891, and strangely enough only upon the treated portions. This dropping of the treated Myrobolan foliage was confined to the leaves situated on the larger

* Bull. No. 3 Div. Veg. Path., p. 58.

limbs in the interior portion of the bushy growth. Although only a small per cent of the foliage was thus affected, the difference between treated and untreated was quite evident. After the lapse of three or four weeks this falling of the leaves ceased. The unbudded stocks which were not treated remained remarkably free from the disease, but in this respect were excelled by the Marianna unbudded, untreated stocks. The budded stocks were not so soon affected as the unbudded, but the Early Prolific "buds" in the untreated section began dropping their foliage in July and throughout the season were manifestly worse affected. The following table shows the data collected in September and October, after all growth had practically ceased:

TABLE 9.—*Showing condition of budded Myrobolan stocks treated and untreated, as regards foliage and measurements.*

Section.	Number, kinds, and treatment of stocks.	Average number of leaves fallen October 10.	Average height above ground September 28.		Average caliper 3 inches above union, October 15.
			Feet.	*Inches.*	
Aa1	11 budded Early Prolific stocks, ammoniacal, 5 treatments	69.8	3	6	14.8
Aa2	16 budded Early Prolific stocks, ammoniacal, 6 treatments	115.8	3	6	14.3
Ab1	18 budded Early Prolific stocks, Bordeaux, 5 treatments	66.0	4	0	15.4
Ab2	13 budded Early Prolific stocks, Bordeaux, 6 treatments	57.5	3	8	16.9
D-I	8 budded Early Prolific stocks, untreated	312.5	3	9	14.3
Ba1	13 budded Purple Egg stocks, ammoniacal, 5 treatments	36.3	4	1	16.2
Ba2	20 budded Purple Egg stocks, ammoniacal, 6 treatments	32.8	4	2	15.1
Bb1	16 budded Purple Egg stocks, Bordeaux, 5 treatments	6.1	3	8	15.4
Bb2	16 budded Purple Egg stocks, Bordeaux, 6 treatments	9.7	4	3	15.6
D-II	10 budded Purple Egg stocks, untreated	123.3	4	7	16.4
Ca1	12 budded Italian Prune stocks, ammoniacal, 5 treatments	15.8	3	10	14.3
Ca2	16 budded Italian Prune stocks, ammoniacal, 6 treatments	8.2	3	7	15.3
Cb1	16 budded Italian Prune stocks, Bordeaux, 5 treatments	7.8	3	6	15.5
Cb2	15 budded Italian Prune stocks, Bordeaux, 6 treatments	6.3	4	0	16.4
D-III	11 budded Italian Prune stocks, untreated	52.8	3	9	15.0

From this table the only conclusion admissible is in regard to the amount of leaf-blight. It is evident that the treated portions lost only a small number of leaves in comparison with the untreated, and in so far the fungicides proved effective.

MARIANNA STOCKS.

1892.—The treatment of these stocks was in all respects identical with that of the Myrobolan stocks and the results were in general similar. The *treated unbudded* stocks lost a number of their leaves from an early attack of the fungus in June and July, but the *untreated unbudded* portion of the row remained remarkably free from the disease throughout the season, more so in this regard than the Myrobolan. The

budded stocks showed little superiority in regard to leaf-blight over the budded Myrobolan and evidently no considerable degree of immunity was afforded by the stock to the scion. But a comparison of the two tables brings out the fact that the Purple Egg "buds" made markedly the best growth upon Marianna stocks. These "buds" averaged more than one-eighth of an inch greater in diameter and were on an average 10 inches higher. The other less rapidly growing stocks did not show such a marked difference, and too much reliance ought not to be placed on data gathered from so small a number of stocks. Certain it is, however, that the Marianna proved superior in this single experiment.

TABLE 10.—*Showing condition of budded Marianna stocks, treated and untreated, as regards foliage and measurements.*

Section.	Number, kinds, and treatment of stocks.	Average number of leaves fallen October 11.	Average height above ground September 28.		Average caliber 3 inches above union, October 15.
			Feet.	*Inches.*	*Inches.*
Aa1.	9 budded Early Prolific stocks, ammoniacal, 5 treatments	98.8	3	3	15.5
Aa2	11 budded Early Prolific stocks, ammoniacal, 6 treatments	63.3	3	6	16.3
Ab1	14 budded Early Prolific stocks, Bordeaux, 5 treatments	99.6	4	4	20.2
Ab2	5 budded Early Prolific stocks, Bordeaux, 6 treatments	71.6	3	2	18.5
D-I	10 budded Early Prolific stocks, untreated	311.2	3	7	15.9
Ba1	17 budded Purple Egg stocks, ammoniacal, 5 treatments	39.1	5	5	21.2
Ba2	23 budded Purple Egg stocks, ammoniacal, 6 treatments	45.1	4	7	20.6
Bb1	17 budded Purple Egg stocks, Bordeaux, 5 treatments	42.7	5	0	21.3
Bb2	21 budded Purple Egg stocks, Bordeaux, 6 treatments	26.9	5	1	20.2
D-II	14 budded Purple Egg stocks, untreated	148.2	5	0	20.5
D-III*	12 budded Purple Egg stocks, untreated	177.2	4	11	19.2
Ca1	19 budded Italian Prune stocks, ammoniacal, 5 treatments	16.8	3	6	17.2
Ca2	24 budded Italian Prune stocks, ammoniacal, 6 treatments	17.5	4	0	14.5
Cb1	20 budded Italian Prune stocks, Bordeaux, 5 treatments	11	4	7	20
Cb2	19 budded Italian Prune stocks, Bordeaux, 6 treatments	12.2	4	2	19

* By another mistake in budding, those stocks which should have received Italian Prune buds were budded with Purple Egg buds.

As regards the effects of the treatments, the only fairly deducible conclusion is that the Bordeaux mixture and ammoniacal solution prevented the disease to a notable degree, sufficient, it is believed, to warrant further extended trial in nursery practice. Although not evident from the table, the ammoniacal solution is in reality inferior to Bordeaux, as it injures the foliage of the treated "buds." On this account it can not be recommended for the treatment of plum stocks. Plates XXVIII and XXIX show the treated and untreated "buds" as they appeared in the experiments.

APPLE POWDERY MILDEW (*Podosphæra oxyacanthæ* (DC) Winter?).

Seedling apples sometimes suffer quite severely from this disease, which attacks their young shoot tips, often stunting the growth of the seedlings and preventing them from attaining a suitable size the first season. Compared with the injury caused by the apple thrips, however, that brought about by mildew is surely insignificant and, in New York State at least, hardly warrants any expensive measures for its prevention. The disease usually appears late in September, when the principal growth has been made, and seldom, if ever, spreads to vigorously growing budded stocks, even when these are in close proximity to diseased seedlings. The malady was not observed on bearing trees in the neighborhood of Geneva.

The experiments for the prevention of this disease comprised in 1891 about 1,000 American stocks and the same number of French stocks, besides 500 seedlings. As stated in a previous publication,* the results of the first season's treatment of the stocks was entirely negative and the treatments of seedlings which were made on May 21, June 3, 24, July 9, 24, and August 8, as well as the early treatments made on the first three dates mentioned, failed entirely to prevent the appearance of mildew the first week in September. Bordeaux mixture and ammoniacal solution alone were used, the formulæ being those described on p. 262. This failure of the fungicides is considered by the author merely as additional testimony to the fact observed that the mixtures were largely washed off before the disease appeared. On August 7 the French and American stocks were budded with Twenty Ounce, Fameuse and Early Strawberry buds, as described in detail on p. 259, and in the season of 1892 the budded, and such of the stocks as were left unbudded were treated with Bordeaux mixture and ammoniacal solution at dates the same as for all other stocks, viz, May 27; June 16, 23; July 7, 21; and August 5. One-half the treated stocks were sprayed 5 times on the first five dates mentioned, the other half were sprayed 6 times.

No powdery mildew appeared during the course of the season, and in October the results of the treatments were entirely negative. The apple thrips, however, attacked the budded and unbudded stocks and injured them severely. The mixtures had, as might be expected, no effect upon these insects.

DETAILS OF THE EXPERIMENTS.

The following pages comprise the details of the experiments, which are removed from the general account in order to render the latter more comprehensible. They will prove of interest only to specialists on the subject.

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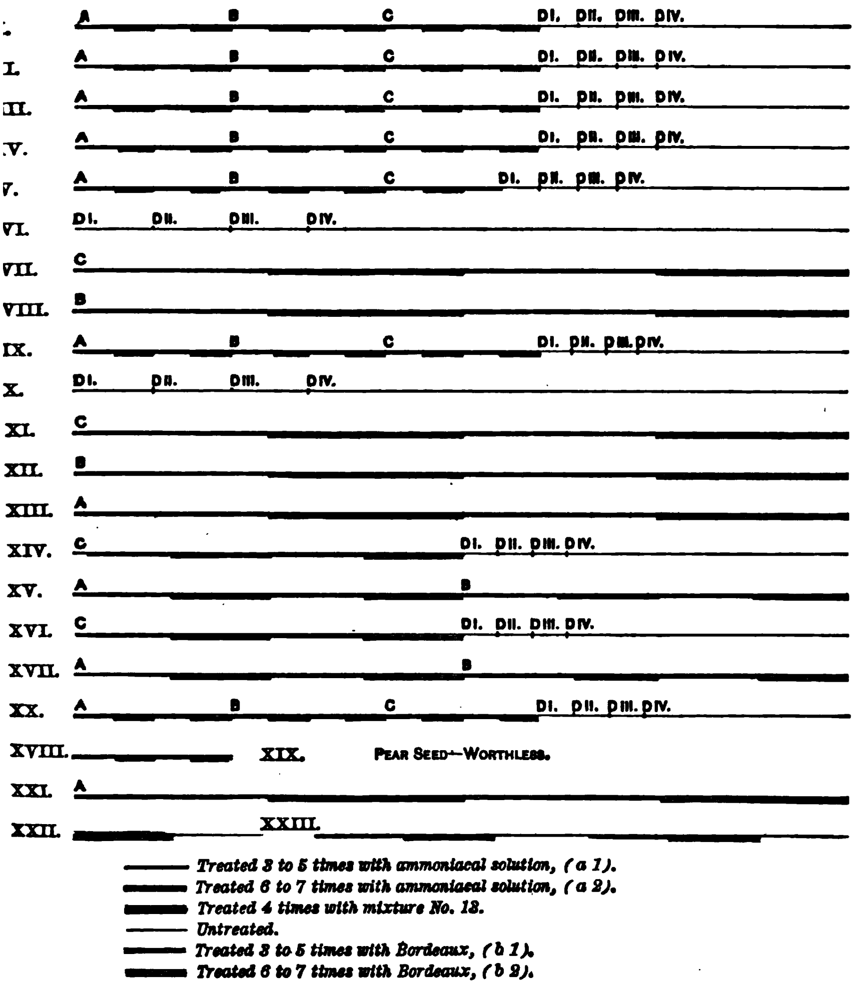
*Bull. No. 3, loc. cit., p. 60.

DIAGRAM 2.—*Plan of nursery experiment at Geneva, N. Y.*



The actual proportions of the experimental field do not admit of any but a diagrammatic representation. The location of the field is designated in the records of the station as "main farm plat B." The rows ran east and west, the west end of each row being indicated by a Roman numeral. These numerals are for convenience of reference (see account following). The capital letters heading the sections of each row refer to the budding. For example: Row I, Section A, was budded with Windsor; Row I, Section B, with Yellow Spanish, precisely as set forth below. The treatments with fungicides which each section and subsection received are indicated by the key below Diagram 2.

The sections of the various rows were budded as below described.

Row I. Mahaleb cherry stocks budded August 5, 1891.

Section A with Windsor.
B with Yellow Spanish.
C with Montmorency.
DI with Montmorency.
DII with Yellow Spanish.
DIII with Windsor.
DIV unbudded.

Row II. Mazzard cherry stocks budded August 5, 1891.

Section A with Windsor.
B with Yellow Spanish.
C with Montmorency.
DI with Windsor.
DII with Yellow Spanish.
DIII with Montmorency.
DIV unbudded.

Row III. Myrobolan plum stocks budded September 10, 1891.

Section A with Early Prolific.
B with Purple Egg.
C with Italian Prune.
DI with Early Prolific.
DII with Purple Egg.
DIII with Italian Prune.
DIV unbudded.

Row IV. Marianna plum stocks budded September 10, 1891.

Section A with Early Prolific.
B with Purple Egg.
C with Italian Prune.
DI with Early Prolific.
DII with Purple Egg.*
DIII with Purple Egg.†
DIV unbudded.

Row V. Angers quince stocks budded August 6, 1891.

Section A with Duchess.
B with Anjou.
C with Flemish Beauty.
DI with Duchess.
DII with Anjou.
DIII with Anjou.
DIV unbudded.

Row VI. French pear stocks budded August 7, 1891.

Section DI with Duchess.
DII with Anjou.
DIII with Flemish Beauty.
DIV unbudded.

Row VII. French pear stocks budded August 7, 1891.

Section C with Flemish Beauty.

Row VIII. French pear stocks budded August 7, 1891.

Section B with Anjou.

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* A variety of recent introduction originated on the Hudson River.

† The budder's blunder in inserting these in place of Italian Prune.

Row IX. Japan pear stocks budded August 5, 1891.
Section A with Duchess.
B with Anjou.
C with Flemish Beauty.
DI with Duchess.
DII with Anjou.
DIII with Flemish Beauty.
DIV unbudded.

Row X. American pear stocks budded August 7, 1891.
Section DI with Duchess.
DII with Anjou.
DIII with Flemish Beauty.
DIV unbudded.

Row XI. American pear stocks budded August 7, 1891.
Section C with Flemish Beauty.

Row XII. American pear stocks budded August 7, 1891.
Section B with Anjou.

Row XIII. American pear stocks budded August 7, 1891.
Section A with Duchess.

Row XIV. American apple stocks budded August 7, 1891.
Section C with Twenty Ounce.
DI with Fameuse.
DII with Early Strawberry.
DIII with Twenty Ounce.
DIV unbudded.

Row XV. American apple stocks budded August 7, 1891.
Section A with Fameuse.
B with Early Strawberry.

Row XVI. French apple stocks budded August 7, 1891.
Section C with Twenty Ounce.
DI with Fameuse.
DII with Early Strawberry.
DIII with Twenty Ounce.
DIV unbudded.

Row XVII. French apple stocks budded August 7, 1891.
Section A with Fameuse.
B with Early Strawberry.

Row XVIII. French apple seeds.
Row XIX. French pear seeds which did not germinate.
Row XX. Peach seedlings which remained healthy.
Row XXI. French pear stocks budded August 7, 1891.
Section A with Duchess.

Row XXII. Plum seedlings of *Prunus domestica.**
Row XXIII. Horse chestnut seedlings.*

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*The results of treatments of plum and horse chestnut seedlings are reserved for future publication.

TABLE 11.—*Showing the number of budded stocks in each treated and untreated section.*

[The small letter a indicates that the stocks were treated with ammonical solution, the letter b that they were sprayed with Bordeaux. The Arabic numeral 1 indicates that the stocks were treated times, the number 2 that they were treated 6 times. The sections marked I–IV were not treated.]

Row.	Kind of stock.	Section.	Variety of bud.	Number budded.	Number left unbudded.
I	Mahaleb	Aa1	Windsor	17	3
		Aa2	do	18	4
		Ab1	do	*13	2
		Ab2	do	20	0
		Ba1	Yellow Spanish	21	2
		Ba2	do	22	1
		Bb1	do	22	0
		Bb2	do	20	2
		Ca1	Montmorency	18	2
		Ca2	do	20	2
		Cb1	do	23	0
		Cb2	do	18	2
		DI	do	11	1
		DII	Yellow Spanish	11	0
		DIII	Windsor	8	0
		DIV	Not budded		40
II	Mazzard	Aa1	Windsor	28	0
		Aa2	do	30	0
		Ab1	do	27	0
		Ab2	do	25	0
		Ba1	Yellow Spanish	29	1
		Ba2	do	29	0
		Bb1	do	31	0
		Bb2	do	31	1
		Ca1	Montmorency	27	1
		Ca2	do	23	4
		Cb1	do	29	1
		Cb2	do	29	0
		DI	Windsor	14	1
		DII	Yellow Spanish	15	0
		DIII	Montmorency	15	0
		DIV	Not budded		62
III	Myrobolan	Aa1	Early Prolific	14	11
		Aa2	do	20	9
		Ab1	do	21	5
		Ab2	do	19	4
		Ba1	Purple Egg	17	8
		Ba2	do	24	6
		Bb1	do	18	8
		Bb2	do	16	7
		Ca1	Italian Prune	13	12
		Ca2	do	17	11
		Cb1	do	18	7
		Cb2	do	18	7
		DI	Early Prolific	13	0
		DII	Purple Egg	13	2
		DIII	Italian Prune	14	1
		DIV	Not budded		71
IV	Marianna	Aa1	Early Prolific	17	6
		Aa2	do	22	6
		Ab1	do	20	5
		Ab2	do	15	7
		Ba1	Purple Egg	19	6
		Ba2	do	27	0
		Bb1	do	17	6
		Bb2	do	22	5
		Ca1	Italian Prune	22	5
		Ca2	do	25	5
		Cb1	do	24	5
		Cb2	do	23	5
		DI	Early Prolific	13	1
		DII	Purple Egg	14	0
		DIII	Purple Egg †	14	0
		DIV	Not budded		80
V	Angers quince	Aa1	Duchess	15	16
		Aa2	do	15	15
		Ab1	do	15	15
		Ab2	do	15	17
		Ba1	Anjou	15	15
		Ba2	do	14	16
		Bb1	do	14	15
		Bb2	do	15	17
		Ca1	Flemish Beauty	15	16

* Five buds of the Montmorency were inserted by mistake of the budder.
† Should have been Fellenburg—mistake of budder.

TABLE 11.—*Showing the number of budded stocks in each treated and untreated section*—Continued.

Row.	Kind of stock.	Section.	Variety of bud.	Number budded.	Number left unbudded.
V	Angers quince	Ca2	Flemish Beauty	15	14
		Cb1	......do	15	16
		Cb2	......do	15	0
		DI	Duchess	15	0
		DII	Anjou	14	1
		DIII	......do*	15	0
		DIV	Not budded	....	97
VI	French pear	DI	Duchess	58	3
		DII	Anjou	59	2
		DIII	Flemish Beauty	58	2
		DIV	Not budded	....	251
VII	French pear	Ca1	Flemish Beauty	59	51
		Ca2	......do	64	59
		Cb1	......do	59	55
		Cb2	......do	62	69
VIII	French pear	Ba1	Anjou	63	62
		Ba2	......do	61	63
		Bb1	......do	59	63
		Bb2	......do	61	60
IX	Japan pear	Aa1	Duchess	15	9
		Aa2	......do	11	11
		Ab1	......do	14	13
		Ab2	......do	12	8
		Ba1	Anjou	14	7
		Ba2	......do	12	12
		Bb1	......do	13	9
		Bb2	......do	14	9
		Ca1	Flemish Beauty	16	8
		Ca2	......do	17	11
		Cb1	......do	13	13
		Cb2	......do	12	13
		DI	Duchess	11	0
		DII	Anjou	13	0
		DIII	Flemish Beauty	14	0
		DIV	Not budded	....	62
X	American pear	DI	Duchess	29	3
		DII	Anjou	28	5
		DIII	Flemish Beauty	33	2
		DIV	Not budded	....	202
XI	American pear	Ca1	Flemish Beauty	71	10
		Ca2	......do	58	11
		Cb1	......do	57	10
		Cb2	......do	70	11
XII	American pear	Ba1	Anjou	56	13
		Ba2	......do	58	8
		Bb1	......do	49	10
		Bb2	......do	63	17
XIII	American pear	Aa1	Duchess	64	21
		Aa2	......do	38	33
		Ab1	......do	39	16
		Ab2	......do	47	14
XIV	American apple †				
XV	American apple †				
XVI	French apple †				
XVII	French apple †				
XVIII	French apple seedlings †				
XIX	French pear seed †				
XX	Peach seedlings †				
XXI	French pear	Aa1	Duchess	53	39
		Aa2	......do	46	37
		Ab1	......do	31	48
		Ab2	......do	27	57

* Should have been Flemish Beauty—mistake of budder.

† As no disease appeared in the apple buds data is not valuable. Apple seedlings were not budded; peach showed no disease; none of pear seed germinated.

Soil, stocks, and buds.—The soil upon which the nursery was planted is considered by practical nurserymen as well suited to the growing of plums and cherries but as lacking somewhat in the qualities which go to make up the best soil for pears and apples, being of insufficient depth and a trifle too light. Immediately previous to the experiment the soil had been planted to corn, but what fertilizers had been used, if any, and what crops were grown anterior to that season, I have not been able to ascertain. No fertilizer was applied before putting in the stocks and the

only treatment the soil received was a dressing in November and December of 1891 of 33 wagon loads of well-rotted barnyard manure from the station manure platform evenly distributed between the rows.

The stocks were furnished by various nursery firms as stated in a previous article,* and the different lots were of apparently equal vigor—first grade with the exception of American pear stocks, which owing to the lateness of the season were third grade. In the planting which was done between the dates of April 27 and May 3, care was taken that each stock was firmly pressed into the soil. Stocks of the same kind from different nursery firms were thoroughly mixed together. In all respects the normal nursery methods were followed out as nearly as possible. The budding was done on the dates above recorded by two experienced budders employed by the Station. The scions for cherry, pear, and apple buds were cut from trees growing in the nursery rows† of Selover and Atwood. Plum scions were furnished by Maxwell & Bro., from their bearing orchard.

Treatment with fungicides.—Only the two well-known fungicides, ammoniacal solution of copper carbonate and Bordeaux mixture were used. The formulæ used in 1891 were those in common use throughout America. The Bordeaux mixture was diluted in the treatments for 1892 and prepared after the manner first proposed by Dr. G Patrigeon.‡

The formulæ are given below:

Ammoniacal solution of copper carbonate, formula used in 1891.

Five ounces of cupric basic carbonate (copper carbonate) dissolved in ammonia (3 to 4 pints of 26 °) and added to 50 gallons of water. Care was taken that all the carbonate was dissolved in the ammonia, enough being added for the solution.

Ammoniacal solution of copper carbonate, formula used in 1892.

Identical with the above in strength. The carbonate was wetted with one pint of water, previous to adding the ammonia, to facilitate the solution.

Bordeaux mixture, formula used in 1891.

Six pounds of cupric sulphate (copper sulphate or bluestone) dissolved in 12 gallons of water. Four pounds of stone lime slaked in a small quantity of water and made up to 3 or 4 gallons of thin milk. The lime was added slowly to the cupric sulphate and the whole made up to 22 gallons.

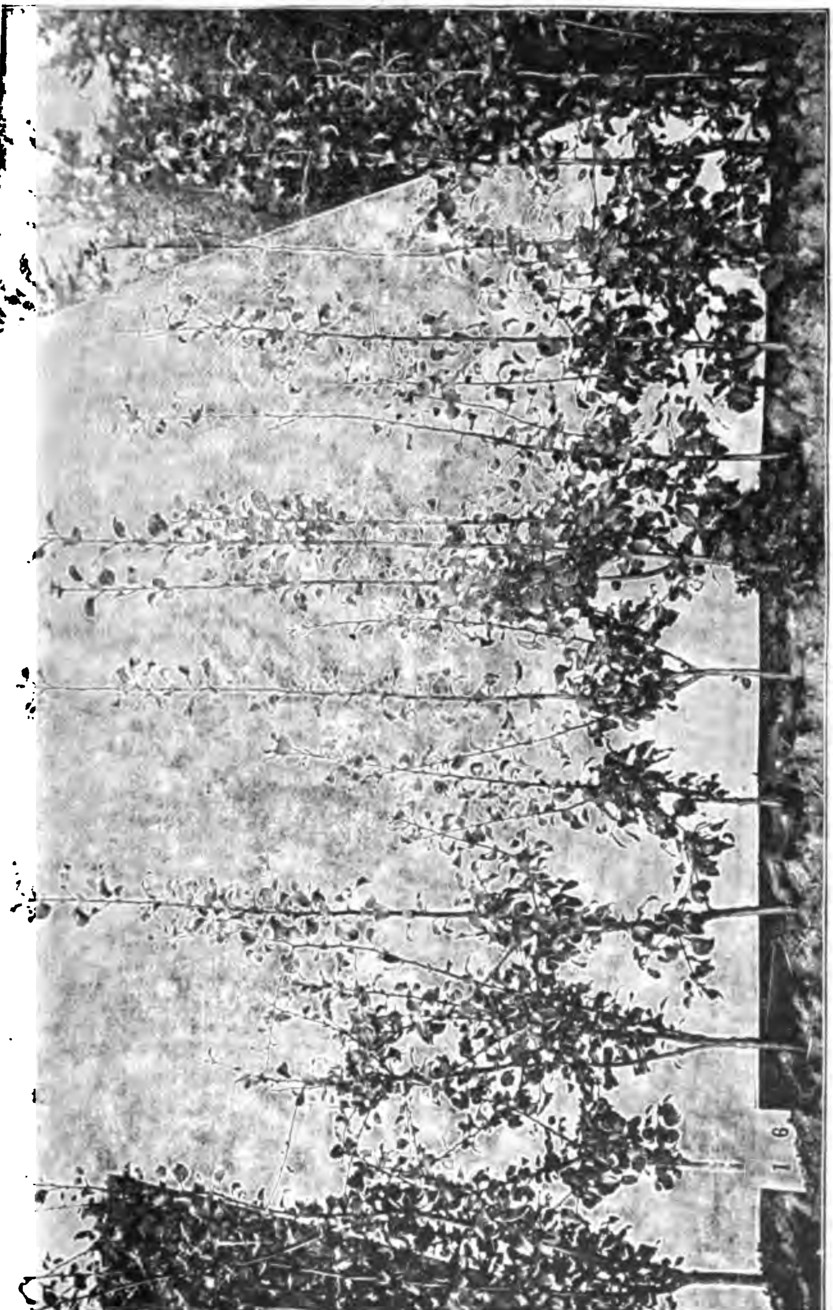
Bordeaux mixture, formula used in 1892.

Two pounds cupric sulphate dissolved in 15 gallons of water. Two pounds Rhode Island stone lime slaked in small quantity of water and made up to 5 gallons. The lime was added slowly to the cupric sulphate, testing the mixture frequently during the addition with a few drops of a concentrated solution of potassium ferrocyanide (yellow prussiate of potash) and ceasing the addition of the lime when no red color was given to the drops of the ferrocyanide. For convenience this may be called a 60-gallon formula, as it requires that amount of water to contain as much copper sulphate as the standard strength, viz, 6 pounds.

* Bull No. 3, Div. Veg. Path., p. 57.

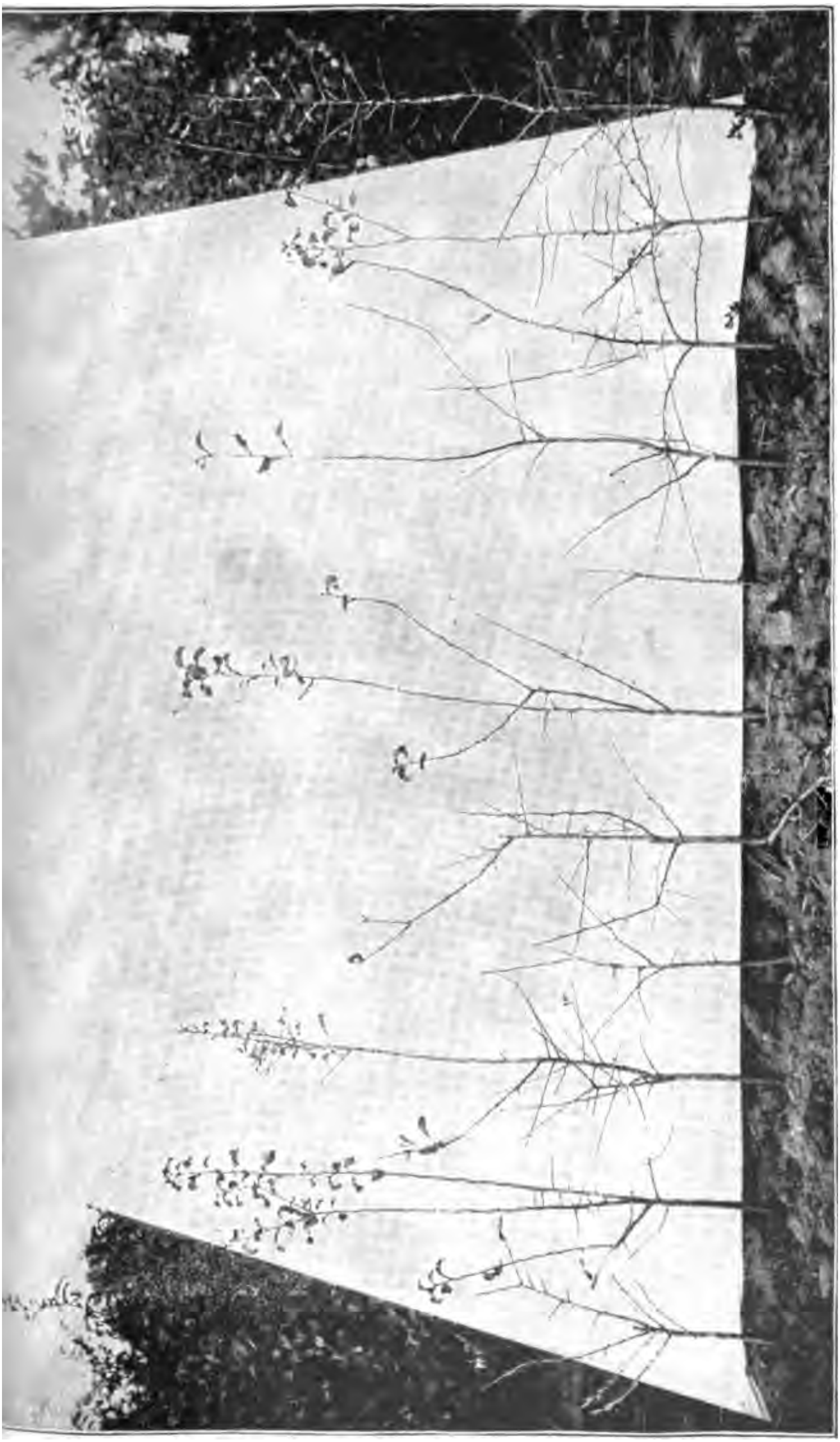
† A practice much in vogue among nurserymen, but certainly not founded upon a knowledge of the laws governing bud variation. The selection of buds from individual bearing trees of known vigor and productiveness is insisted upon by the best cultivators.

‡ Patrigeon, G. *Revue Viticole*, <Jour. d' Agric. Pratique, 1890, t. I. 54e année, p. 701.



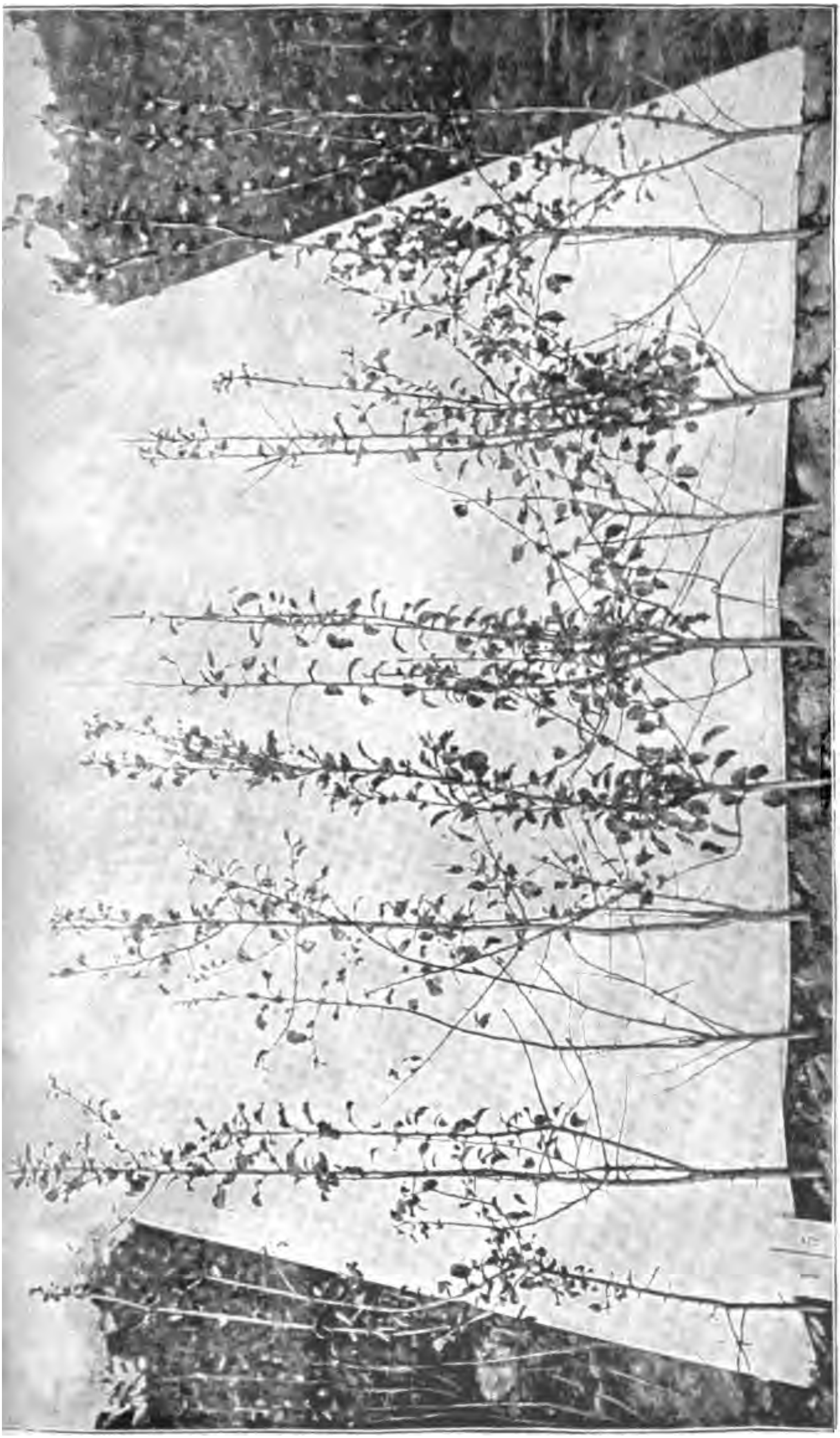
PEAR LEAF-BLIGHT.

French pear stocks. Treated with Bordeaux mixture. (Fairchild.)



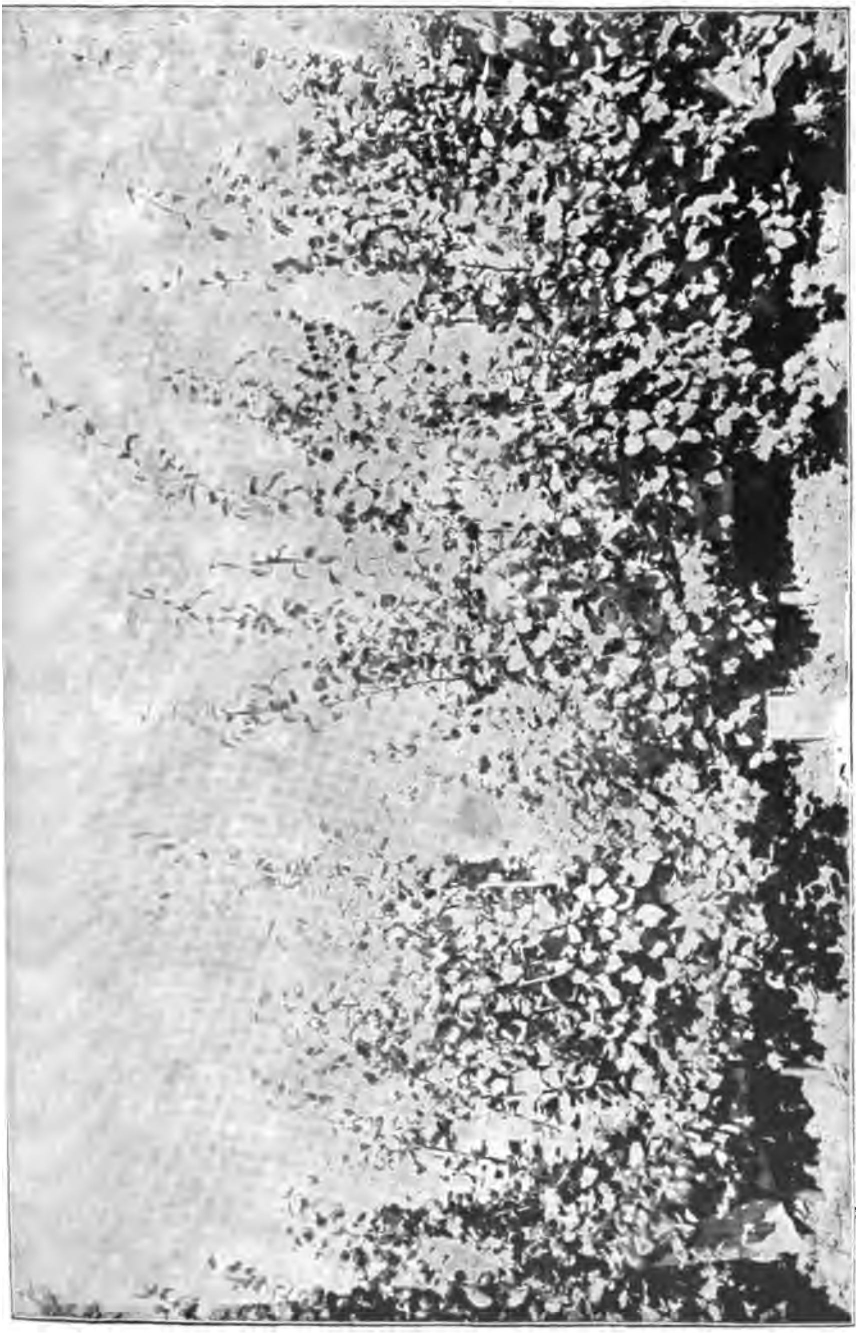
PEAR LEAF-BLIGHT.

French pear stocks. Untreated. (Fairchild.)



PEAR LEAF-BLIGHT.

French pear stocks. Treated with ammoniacal solution. (Fairchild.)



QUINCE LEAF-BLIGHT.

Angers quince stocks. Treated with Bordeaux mixture. (Fairchild.)

Quince Leaf-blight.

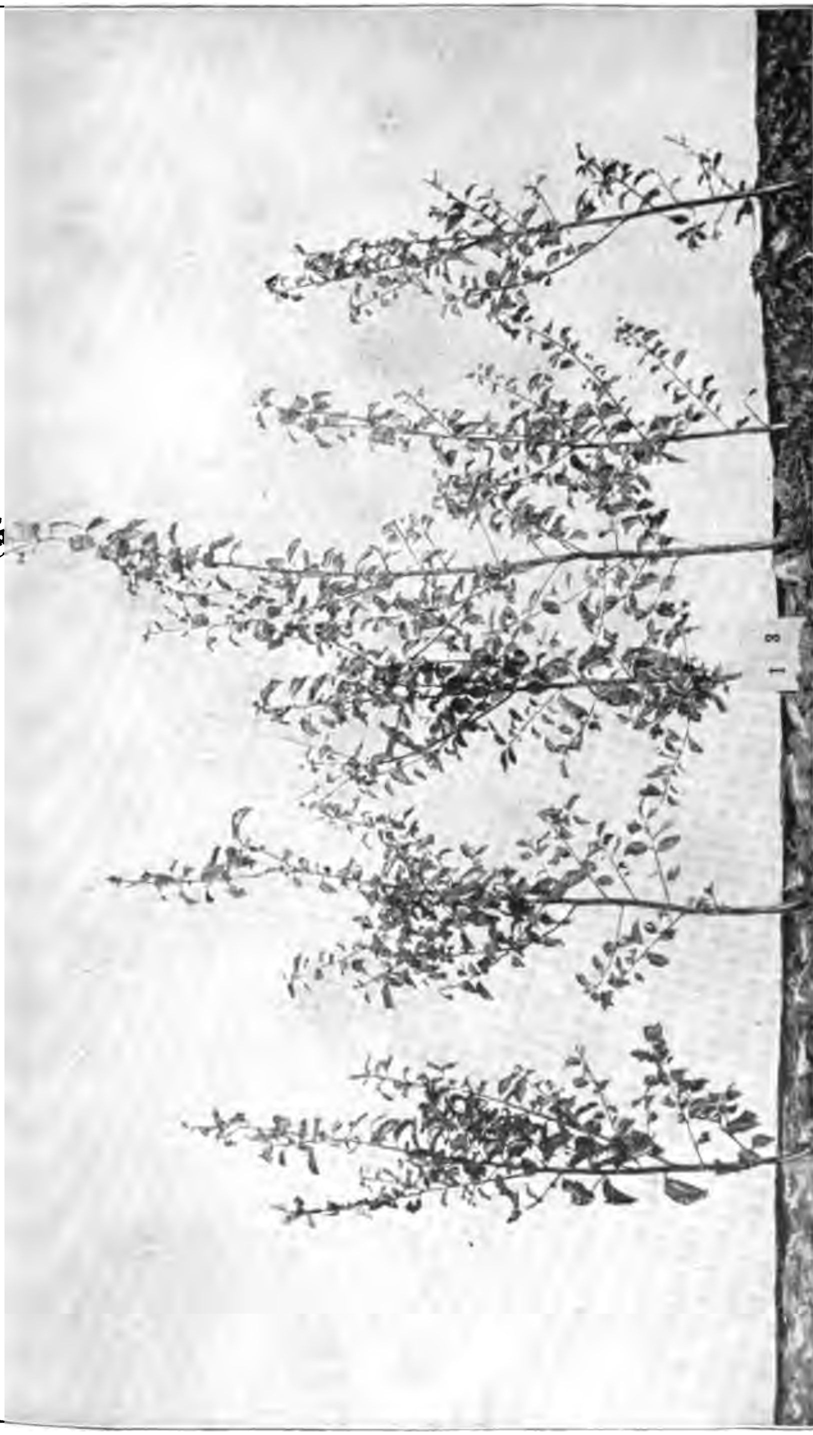
Angers quince stocks. Untreated. (Fairchild.)

CHERRY LEAF-BLIGHT.

Vindsor buds on Mahaleb stocks. Treated with Bordeaux mixture. (Fairchild.)

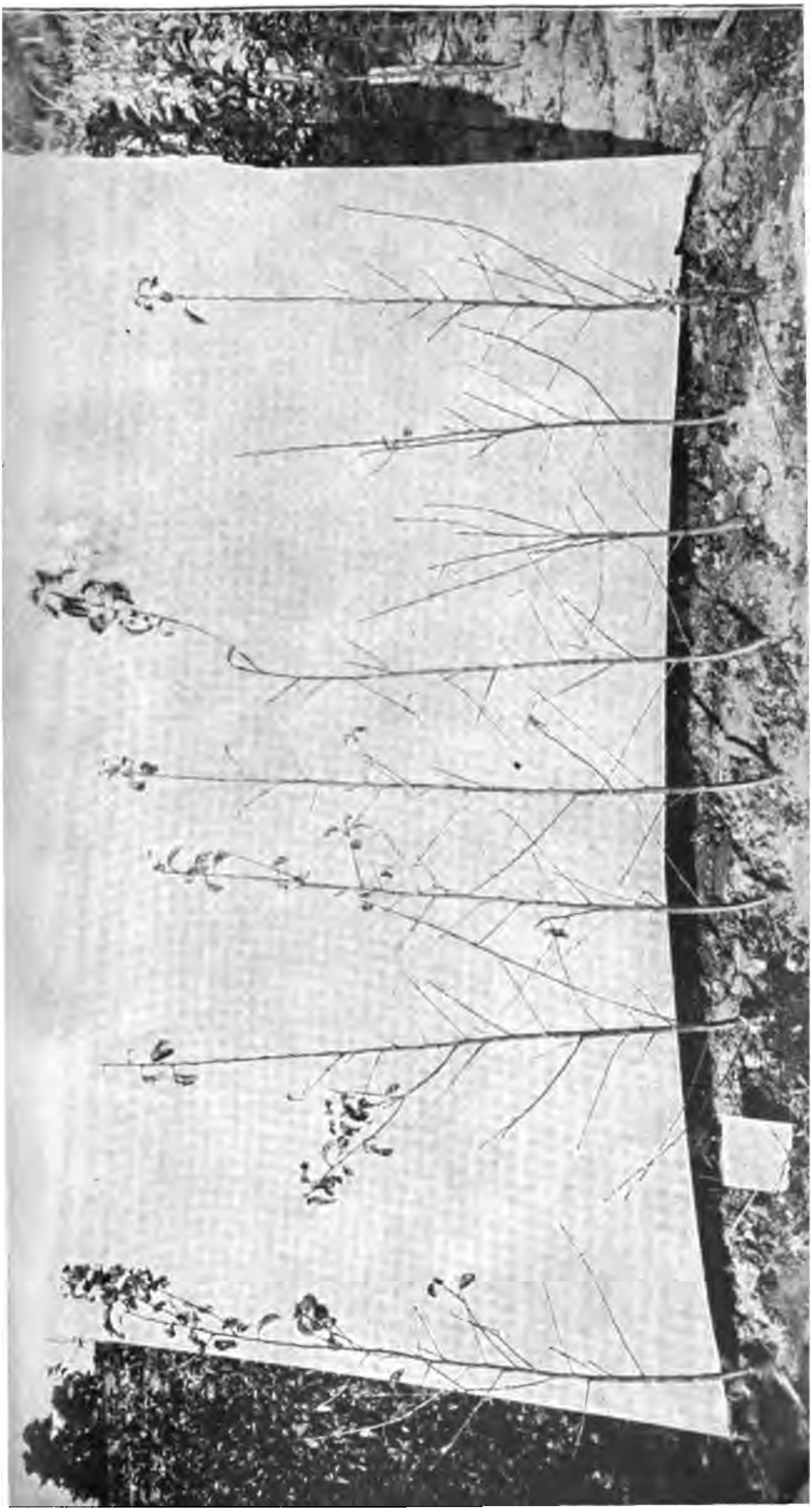
CHERRY LEAF-BLIGHT.

Windsor buds on Mahaleb stocks. Untreated. (Fairchild.)



Plum Leaf-blight.

Early Prolific buds on Myrobolan stocks. Treated with Bordeaux mixture. (Fairchild.)



The treatments were begun in 1891 about three weeks after planting, when the :st leaves were nearly three-fourths grown. The dates upon which the applications ere made were May 21, June 3, June 24, July 9, July 24, August 8, and August 28. s indicated above in the plan, half of each section was treated three times. Those eated three times were sprayed on the first three dates mentioned.

In 1892 the treatments were begun on May 26, when the leaves had attained full ze, and the first appearance of the disease was observed. The dates of treatment re May 26-27, June 15-16, June 23, July 6-7, July 21, and August 5. In order to pply the mixture more thoroughly the spray was passed rapidly over the plants nd the operation repeated after the first spraying had dried.* This method insured s near a complete coating of the fungicide as possible, and it was found that the ordeaux mixture of this weak strength adhered with remarkable tenacity, being lainly visible twelve weeks after application.† Care was taken to spray the under ide of the leaves on the cherry and plum stocks, but pear, quince, and apple tocks were sprayed from above.

The treatments of 1892 were not continued so late in the season as those of 1891, nd the different sections received respectively five and six sprayings, instead of three nd six as in 1891. Those receiving five sprayings were treated on the first five dates nentioned above. The actual amount of the fungicides used will be of little value in stimating the quantities that will be necessary in treatments on a large scale, but or the convenience of other experimenters it may be roughly estimated to equal 3½ o 4½ gallons of solution per 1,000 one-year-old stocks and proportionately more or budded stocks. By one-year-old stocks is meant stocks previous to budding.

The spraying was done with a W. & B. Douglass "Perfection" knapsack sprayer, which proved moderately satisfactory, although a hand-wheel machine would unloubtedly have been better.

DESCRIPTION OF PLATES.‡

PLATE XXI. French pear stocks, planted in 1891 and treated 7 times with Bordeaux mixture, full strength; left unbudded in the fall and treated 6 times with Bordeaux, one-third strength, in 1892. These could properly be called 3-year-old seedlings. Situation of stocks, Row VIII, east end.

XXII. French pear stocks, similar to those in Plate XXI, but without treatment either in 1891 or 1892. Situation of stocks, Row VI, east end. Showing defoliation caused by *Entomosporium*.

XXIII. French pear stocks, similar to those in Plate XXI, but treated 7 times in 1891 and 6 times in 1892 with ammoniacal solution. Situation of stocks, Row VIII, near center.

XXIV. Angers quince stocks, planted as cuttings in 1891 and treated 7 times with Bordeaux full strength the first season, left unbudded in the fall, and treated 6 times with Bordeaux one-third strength in 1892. These could properly be called 3-year-old cuttings. Situation, Row V, near east end.

XXV. Angers quince stocks, similar to those in Plate XXIV, but without treatment either in 1891 or 1892. Situation, Row V, east end, one rod east of those in Plate XXIV. Showing defoliation by *Entomosporium*.

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* Suggested first by N. A. Cobb, Dialogue concerning the manner in which a poisonous spray does its work in preventing or checking blight. <*Agricultural Gazette N. S. Wales*, Vol. II, pp. 779-786.

† These double sprayings were made on the first, fourth, fifth, and sixth treatments only.

‡ All plates are reproduced from photographs taken 8 feet from the stocks on September 29 and October 11.

PLATE XXVI. Windsor "buds," on Mahaleb. The Mahaleb stocks were tr 7 times in 1891 with Bordeaux mixture and the "buds" w treated 6 times in 1892 with Bordeaux one-third strength. S uation, Row I, near west end.

XXVII. Windsor "buds," on Mahaleb. Similar to those in Plate XX but untreated both in 1891 and 1892. Situation, Row I, ne east end, showing defoliation by *Cylindrosporium*.

XXVIII. Early Prolific "buds," on Myrobolan. The Myrobolan st were treated 7 times in 1891 with Bordeaux and the "b were treated 6 times with Bordeaux one-third strength in 18 Situation, Row III, west end.

XXIX. Early Prolific "buds," on Marianna. Similar to those in Pl XXVIII, but untreated both in 1891 and 1892. (The differe of stocks upon which budding was done made no differ as regards the leaf-blight; hence the fact that the "buds" Plate XXVIII were on Myrobolan stocks and in Plate XXI were on Marianna does not affect the comparison.) Situatio Row IV, east end.

EXPERIMENTS WITH FUNGICIDES IN THE REMOVAL OF LICHENS FROM PEAR TREES.

By M. B. WAITE.

(Plates XXX, XXXI.)

While conducting experiments in the large Bartlett pear orchard near Scotland, Va., on the James River, owned by the Old Dominion Fruit Company, the abundance of lichens on the trees attracted attention. Below are given a few notes on their occurrence, and some observations on the effects of Bordeaux mixture and other fungicides upon them.

Lichens are not ordinarily regarded as injurious to the trees on which they grow. They are epiphytic rather than parasitic, many species living on old fences and rocks, as well as on the bark of trees. Orchardists are more apt to regard them as injurious than botanists, the former generally looking upon them as obnoxious. The fact that various washes have been recommended to be used on fruit trees against the lichens as well as the insects they foster, is some evidence of this. Scraping the bark of the trees has also been recommended for removing these pests.

Lichens seem to attack most severely trees which are not in a vigorous condition. Trees not well fed, and weakened by leaf-blight or other fungous diseases, foster them better than healthy trees and no doubt become still further weakened by their load of lichens. The question of course arises: Is the tree made less thrifty by the lichens or is it infested with lichens because it is not thrifty? At any rate trees badly infested are usually weak trees, inferior to the general average of the orchard, and present a very ragged appearance. The presence

of lichens on the trees is certainly not desirable even if not positively objectionable.

It should be noted that the lichens live not only on the rough exfoliating bark of the trunk and larger limbs, but on the smooth growing bark of the smaller branches. In fact the smooth branches seem to have considerably more on them than the old trunks. The fruticose forms are firmly attached to the smooth bark by a small, expanded, disk-like portion of the thallus. The crustaceous forms grow tightly appressed to the bark, or, according to Tuckerman,* the lowest forms grow beneath the outermost layers of the cells of the bark. We see how closely the lichen structure is united to its supporting bark. If not in actual contact it is separated from the green, living bark cells only by an exceedingly thin layer of cork three or four cells deep and not thicker than tissue paper. Furthermore, many species seem to be restricted to the smooth bark. It seems highly probably then that lichens which are in such close connection with the living bark and are more or less restricted to it, take something from the tree. Possibly this consists only of some essential mineral matters, but perhaps also of elaborated sap, and even if they take nothing from the trees their presence may seriously interfere with the functions of the bark.

The Bartlett pear orchard above mentioned has been planted about seventeen or eighteen years. The trees were headed low, and allowed to grow as low, pyramidal standards. Many of the trees had their branches completely fringed with lichens (see Plate XXX). Where the fruticose and foliaceous forms did not cover the limbs the spaces were filled with the crustaceous species. The fringe-like and foliaceous forms are more conspicuous, but the crustaceous forms are probably more injurious.

I am inclined to think that lichens, when abundant, do considerable injury to the trees, although it is hard to get any positive evidence to bear out this belief. The badly infested trees occur in this orchard in patches of several acres in extent, although almost anywhere on the 200 acres the trees were found carrying more or less of the crustaceous forms, if not the larger growths. The crust-like lichens give to the normally smooth yellow bark a grayish, dappled, or spotted appearance, noticeable from a distance.

EXPERIMENTS WITH BORDEAUX MIXTURE.

A block 10 trees square, containing in all about 80 trees, was severely pruned back, the whole top of each tree being removed, leaving only the body and main limbs. This severe treatment and the washing described below were directed primarily against a twig disease, which will be reported on at another time. The object was to remove the twigs and small branches and then to disinfect the remaining parts of the tree of all fungi, lichens, etc.

*Synopsis of North American lichens, p. VIII.

At the suggestion of Mr. Galloway, Bordeaux mixture was tried for this purpose, applied with a whitewash brush. This treatment was entirely successful against the lichens. The strength used was double that of the old formula, or 6 pounds of copper sulphate and 4 pounds of lime in 11 gallons of water. The mixture was applied to about two-thirds of the trees March 16. A storm of rain and snow freezing on the trees stopped the work, but the remaining trees were painted three or four days later. In using the mixture we had some little difficulty in wetting the lichens by means of a brush. It was slower painting a tree covered with fringe-like lichens than one with smooth bark. Ten minutes was found to be a rather short time to cover one of these small trees. Probably two minutes would suffice for thoroughly wetting the same trees with a sprayer, although a more dilute mixture would have to be used.

It was evident at the time of making the applications that the mixture was taking effect. A few minutes after being wet with the mixture the lichens assumed a greenish, ochraceous color, quite different from their normal grayish tint. On visiting the place again on April 8 examination showed that the lichens were all dead. The fruticose and foliaceous forms were drooping and shriveled, while all were colored a yellowish or brownish tint (see Plate XXXI). During the spring further opportunities occurred for observing the effect of Bordeaux mixture on lichens while spraying trees in the same orchard for leaf-blight and other fungous diseases. For this purpose the diluted formula (6 pounds of copper sulphate and 4 pounds of lime in 50 gallons of water) was used. Although no special effort was made to spray lichens with the mixture, it was found that whenever thoroughly wet with it they were killed. The weak Bordeaux turned them yellow in the same way as did the strong mixture painted on the trees. On the foliaceous forms, whenever a few tiny drops of the spray struck, the yellow spots resulting were plainly visible. Probably the best way would be to use the regular old formula for Bordeaux and apply it with a sprayer when any considerable number of trees are to be treated, unless it should be demonstrated that the more dilute Bordeaux is equally effective.

EXPERIMENTS WITH OTHER FUNGICIDES.

The satisfactory results with Bordeaux mixture led to the belief that eau celeste might be still more effective. This fungicide is more corrosive to the leaves of higher plants, and is in solution, so that it can be absorbed by a lichen. It was also thought desirable to test different strengths. For this purpose eau celeste was made up according to the original formula, and dilutions made of part of this by adding 2, 3, and 5 parts of water to 1 part of the mixture. Each strength of the fungicide was sprayed upon the lichen-covered trunks of 3 trees until the lichens were wet. A branch of foliage on each tree was also sprayed to

comparison. At that date the petals of the pear trees were falling and the young leaves just expanding.

One week after the application notes were taken as to the effect. On each tree foliage on the sprayed branch was injured, even where the mixture was diluted 5 to 1. The injury consisted of small brown specks occurring over the leaves and larger brown spots around the margins where the liquid had collected in drops. Besides this there was a general yellow appearance and arrested growth. The one-sixth strength did very nearly as much damage as the full strength. The lichens seemed to be harmed but little. The foliaceous forms were discolored somewhat and were injured the most. They were turned slightly reddish or purplish. The fruticose forms were not visibly changed. As with the foliage, the results from using different strengths of the solution varied but little. The full strength was scarcely more effective than the one-sixth dilution. The strong solution turned the foliaceous forms a little redder and scorched the leaves a little more, the difference being only in degree. An examination of the trees in July showed no decided further change in the sprayed lichens, and altogether the effect of eau celeste was unsatisfactory and indefinite. The injury to the foliage would make no difference because the treatment could be made in winter.

At the time the experiments with eau celeste were carried on, a trial was made with chloride of lime, 1 per cent solution, and bichloride of mercury, one-tenth of 1 per cent solution. Both of these solutions caused the foliage to become of a sickly yellow color, but had scarcely any effect on the lichens. They were turned a little yellow in a few places where the solution settled in drops, but the majority looked all right.

CHEMICAL ACTION OF BORDEAUX MIXTURE ON LICHENS.

Bordeaux mixture seems to have some chemical action on the lichen substance. When a drop of it falls upon a dry lichen there is at first no visible action. In the course of a minute or two the drop, which consists of a clear liquid with the blue, flocculent copper compound suspended in it, begins to turn yellowish, and the lichen beneath it takes on the same color. That the color of the liquid was real and not due to the lichen beneath it was proved by removing a colored drop with a small glass tube, in which it still retained its yellow color. The drop gradually becomes yellow and in course of ten or fifteen minutes will disappear, partly by evaporation and partly by being absorbed by the lichen. The result is a greenish yellow spot, with a few blue grains of the copper compound on the surface. It may be that there is some substance in lichens that acts on the blue precipitate of the Bordeaux and dissolves a portion of it, otherwise how could an insoluble compound penetrate a lichen thallus and destroy it? The clear liquid separated from the blue precipitate had no such effect, nor

did the lime alone without the copper, as a trial demonstrated. There seems to be some mutual reaction between the Bordeaux and the lichen substance, probably the fungous part, since a test with unicellular algæ gave no such results. This point is worthy of further investigation, and is of interest on account of the possibility of its throwing light on the general question of the action on fungi of the copper compound in Bordeaux mixture and in other insoluble copper preparations. Microscopical examination of a small portion of a lichen thallus which had been treated with Bordeaux mixture and had turned yellowish and dried, showed no marked changes. The chlorophyll, however, had turned a brighter yellow color, and to this is probably due the general change of color.

SUMMARY.

(1) Bordeaux mixture is an effective remedy for lichens on pear trees.

(2) Eau celeste, chloride of lime, (1 per cent solution) and bichloride of mercury, (one-tenth of 1 per cent solution) proved unsatisfactory.

(3) There seems to be a reaction between the lichens and the Bordeaux mixture in which the flocculent precipitate constituting the active principle of the latter is probably partially dissolved and absorbed. As a result the lichens assume a yellow color and die.

DESCRIPTION OF PLATES.

Plate XXX. A Bartlett pear tree near Scotland, Va., infested with lichens. From a photograph taken October 19, 1892.

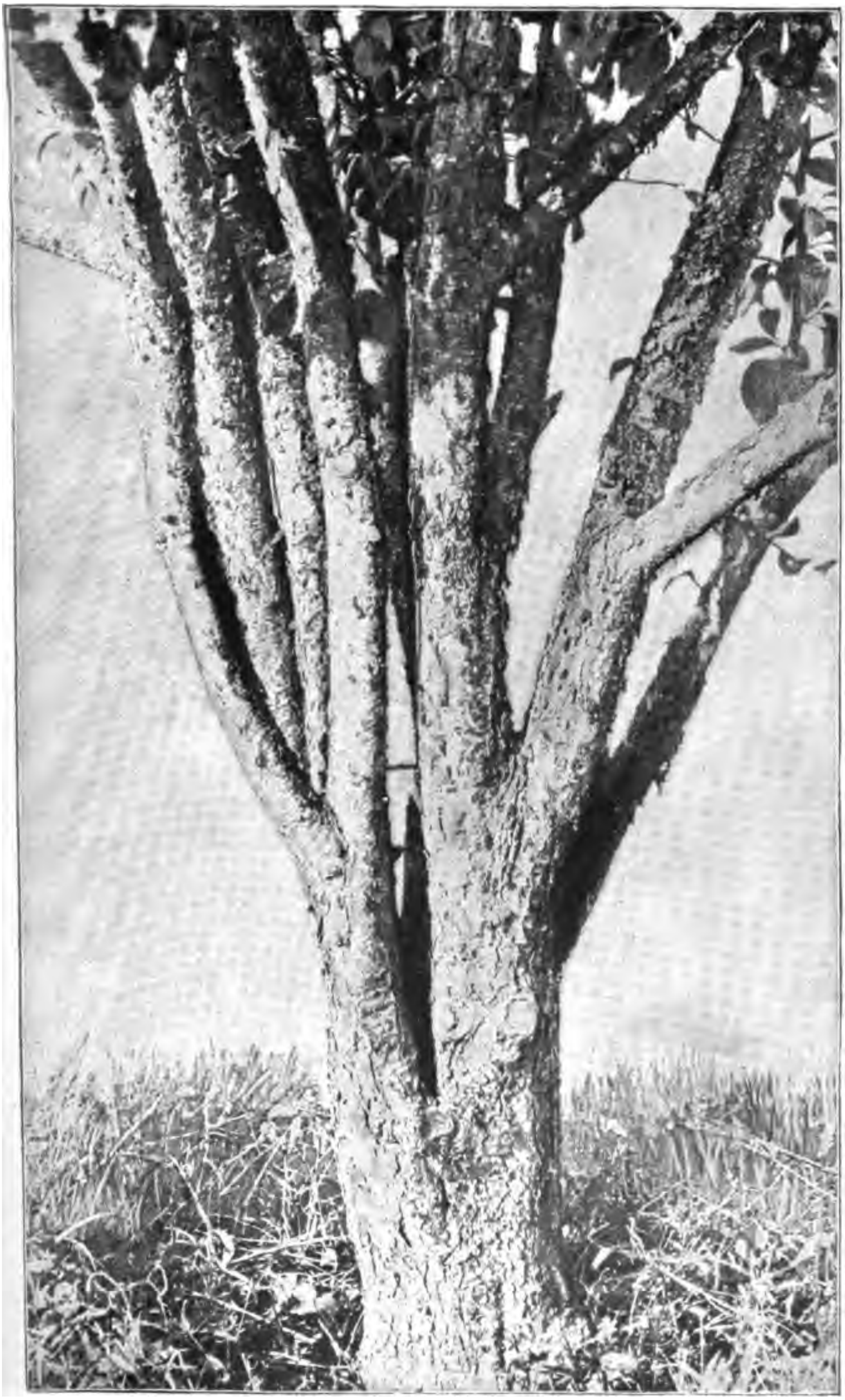
XXXI. Bartlett pear tree in the same orchard which had been treated with Bordeaux mixture, showing the dead and shriveled remains of the lichens. From a photograph taken October 19, 1892.

NOTES ON FOSSIL FUNGI.

By Joseph F. James.

The enormous number of species and individuals of living fungi presupposes their existence in the past. But their evanescent nature and their peculiar structure render their occurrence in a fossil state comparatively rare. There is great difficulty in keeping many of them with all the care and experience of botanists, and it is natural to expect the vicissitudes of time will operate against rather than in favor of their preservation. During those periods of geological time when vegetation was mainly confined to the sea, we can scarcely expect to find fungi, so that not until the Devonian epoch need we look for evidences of their presence. The Carboniferous period, however, with its

ANCHES OF BARTLETT PEAR TREE UNTREATED AND COVERED WITH LICHENS. (WA



BARTLETT PEAR TREE AFFECTED WITH LICHENS AFTER TREATMENT WITH BORDEAUX MIXTURE. (WAITE.)

nderful richness of vegetation, might be expected to produce a ɜater or less number of species. As a matter of fact, however, they ve so far been very rarely found in this formation, and it seems doubt- whether some of those that have been described as fungi are really ɔh. Perhaps the preponderance of ferns, lycopods, and similar forms ıy partly explain the absence of parasitic fungi, for we know that these ınts in our days are rarely attacked by them. The peculiar con- :ions of deposition of the coal also militate against the preservation saprophytic forms. Experiments made by Lindley about 1835 to certain the probability of plants being preserved in water show that 3 species of woody fungi only shapeless masses remained at the d of two years.* In Cretaceous and Tertiary times, when the gher types of dicotyledons predominated, parasitic species are more :ely to occur, and here they are not uncommon. In the following ıtes upon some of the species described as fungi and occuring in e older geological formations an endeavor has been made to ascertain eir actual position.

The earliest described species, supposed to be a fungus, to which reference has been found was named by Lindley and Hutton in 1831, *ɔlyporites bowmanni*.† The authors considered it doubtful whether it ally belonged to the vegetable kingdom, but they compared it with ɪrtain fungi having a hymenium, like *Boletus*, *Polyporus*, etc. In 1877 esquereux‡ referred to the species and discussed its nature, stating ıat a specimen somewhat similar had been found in the anthracite Coal Measures near Pottsville, Pa. It did not, however, throw ıy light upon the true nature of the fossil. It is compared to ɜrtain shaly fragments colored in concentric zones by iron, and which ccur in the Tertiary lignite of the Rocky Mountains. Finally, in 1889 Villiam Carruthers stated that instead of its being a fungus it had een ascertained to be the scale of a ganoid fish.§ Thus *Polyporites owmanni* was at last disposed of.

In 1869 Hancock and Atthey published a paper "On some curious ossil fungi from the black shale of the Northumberland coal field."‖ 'hey stated that in the interior of certain lenticular bodies they ound numbers of ramifying tubes. They were not calcareous, and vere considered to be fungi. A comparison was made with *Scle- ɾotium stipitatum* B. & C., 1862, and the statement made that the de- ɕription of that species would fit one of the fossil forms very well. Some of the lenticular bodies appear homogeneous, but this is consid- ɜred merely apparent.¶ Occasional oval, spore-like bodies were found n the threads, and scattered through the substance of the fungus. In

* Fossil Flora of Great Britain, by Lindley and Hutton, Vol. III, 1837, p. 5.
† Loc. cit., Vol. I, 1831-'33, p. 185, pl. 65.
‡ Proc. Am. Phil. Soc., Vol. XVII, 1877, p. 173.
§ Proc. of the Geol. Asso., Vol. XI, London, 1889, p. xxi.
‖ Ann. & Mag. Nat. Hist., 4th ser., Vol. IV, 1869, pp. 221-228, pls. ix, x.
¶ Out of 126 sections made, 16 appeared homogeneous.

some cases there was an outer part composed of two or three layers. The forms were referred to the genus *Archagaricon* (p. 226), with five species, as follows: *A. bulbosum*, *A. globuliferum*, *A. radiatum*, *A. dendriticum*, and *A. conglomeratum*. The first (*A. bulbosum*) is the only species illustrated. It is probable that these bodies are really fungoid in their nature, but it seems scarcely justifiable to make so many species.

In 1877 Worthington G. Smith referred to this paper* and said that while one of the figures might pass for a species called by himself *Peronosporites antiquus*, "drawn by a bad draftsman, unacquainted with fungi," the descriptions were too indefinite to determine what the writers really had in mind.

In this same paper† Mr. Smith described a fungus under the name mentioned above. He observed it in the stem of a species of *Lepidodendron* from the Coal Measures, and described the hyphæ as septate and bearing oögonia, which contained zoöspores. Further, he stated that an enlargement of the fossil to 400 diameters showed the oögonia to be the same in size and character as similar structures belonging to the potato fungus. The average number of zoöspores in each he said was also the same, namely, seven or eight. While these observations of Mr. Smith have been criticised in many quarters,‡ it is probable that the body described is a fungus. Mr. Carruthers considers it to be such, without question. In his "Diseases of Field and Garden Crops," published in 1884, Mr. Smith referred to the criticisms that had been passed upon the fossil from time to time, and reiterated his statement that traces of zoöspores are visible in the oögonia. In Massee's recent volume,§ the subject is again discussed, and the conclusion is that the species is perhaps as well placed in the *Peronosporeæ* as in the *Saprolegnieæ*, where Williamson thought it belonged.

It should be mentioned here that DeBary has questioned the accuracy of Smith's observations in regard to the presence of oöspores and zoöspores in the living *Phytophthora infestans*. Sexual organs, however, have been observed in another species of the genus (*P. omnivora*),‖ and their presence may yet be demonstrated to the satisfaction of all in *P. infestans*. DeBary says that "septa occur in the mycelium of *P. infestans*, especially when old, but they are always isolated and very irregular." ¶ The imperfect preservation of the fossil *Peronosporites* probably accounts for the conflicting statements that have been made in regard to it. It is, too, scarcely to be expected that

* Gard. Chron., new ser., Vol. VIII, London, 1877, p. 499.

† A fossil Peronospora (*Peronosporites antiquus* W. Sm.).

‡ By Murray in the Academy, Nov. 17, 1877, who denied the existence of the zoöspores; and by Williamson in the Philosophical Transactions of the Royal Society of London Vol. CLXXII, p. 299. The latter stated that the relations of the fungus were more probably with *Saprolegniæ* than *Peronosporeæ*.

§ British Fungi: Phycomycetes and Ustilagineæ, London, 1891, pp. 213–216.

‖ Bennett & Murray, Cryptogamic Botany, 1889, p. 327.

¶ Jour Roy. Agric. Soc. England, Vol. XII, London, 1876, p. 262.

t will ever be found so excellently preserved as to settle positively its true position in classification. Bennett and Murray state that "mycele and bodies which may well be oögones are visible in the preparations" of Mr. Smith.*

A remarkable paper on fossil plants by Prof. P. Martin Duncan, has been published in the proceedings of the Royal Society of London.† The title is, "On some Thallophytes parasitic within recent Madreporaria." In the course of the paper he refers to the work of other writers on organisms in corals. The time range of the various parasites is very great, as corals from the Lower and Upper Silurian and Tertiary formations show their presence. In the latter case even the cell wall is preserved. Their vertical range in the ocean extends from the surface to a depth of 1,095 fathoms, and they can exist under temperatures ranging from 39.7° to that of the surface water. The parasitic growths are observed by means of thin transverse and longitudinal sections. Age and length of time since the canals were bored seem to have no influence on them, for they are just as perceptible in Tertiary as in recent corals. The usual appearance of the canals is that of long, dark lines, with a clear central space. The lines may branch, but are of the same size in stem and branch. Swellings are frequent and granular masses often fill spaces in the canals. Prof. Duncan proposes for the parasite the name of *Achlya penetrans*. In regard to the fossil forms he says:

> From the results of my examination of Upper Silurian corals and of Lower Silurian arenaceous Foraminifera, it is evident that a parasite closely resembling *Achlya penetrans* lived within them during those remote ages. Corresponding in shape with the Silurian form of parasite are others which are fossil within the corals of later ages. The main differences between the ancient and modern forms consist in the larger caliber of some of the filaments of the first, their long, often unbranching course, and the frequent development of *Conidia*-looking bodies within them, and the spherical shape of the spores; but it is quite possible that these are not distinctions which are of specific value.
>
> The modern coral parasite is evidently the descendant, with slight, or possibly no modification, of those which have flourished during successive world-wide changes in floras and external conditions. Hence it would, in all probability, have had its life cycle made complicated, and a metamorphosis involving vegetative and mobile stages has been superadded. It is not an assimilator of putrescent or rotten animal matter, but of the nitrogenous and undecomposed organic basis of the coral; and in this it resembles the organisms which destroy some living diptera and other aërial insecta. Moreover this resemblance in function is possibly caused by continuance of individuality; and if this be true, it adds vastly to the difficulty of placing the parasite in a philosophical scheme of classification (pp. 252–253).

The lowly organization and the simple structure of many fungi have been the possible cause of the continued existence of many of them through long periods of time. We seem scarcely prepared, however, to realize that the forms existing as parasites within corals of Silurian

* Loc. cit., p. 330.

† Abstract in No. 171, Vol. xxv, 1876, pp. 17–18; complete in No. 174, Vol. xxv, 1876, pp. 238-257, pl. 3.

age are the same as those now living in inhabitants of the ocean. So when we remember that the fungus simply produces threads or filaments with the occasional addition of spores; that the bathymetric conditions have probably remained nearly the same, and that the hosts alone have changed since early geological time; and further that the fungus causing potato rot had at least its representative in plants of the Carboniferous age, it does not seem so strange to find long-lived forms under other conditions. If, however, the parasitic *Achlya penetrans* of modern seas is identical with the parasite of Silurian seas, the case is without a parallel in the organic world.

In 1877 Prof. L. Lesquereux published a paper entitled "A species of fungus recently discovered in the shales of the Darlington coal bed (Lower Productive Coal Measures Allegheny River series) at Cannelton, in Beaver County, Pa."* The name *Rhizomorpha sigillariæ* is given to the specimen, which was found beneath the bark of a species of *Sigillaria*. A figure of it was sent to Dr. Casimer Roumeguere, of Toulouse, France, who concluded that it bore a great resemblance to living examples of *Rhizomorpha*. The figure given by Lesquereux is reproduced below. (Fig. 1.)

FIG. 1.—*Rhizomorpha sigillariæ*. Lesqx.

The striking resemblance which this figure had to certain insect burrows under the bark of trees was pointed out by the writer in 1885† and a further examination confirms this belief in its origin. The genus *Rhizomorpha* is now recognized as simply the sterile mycelium of various species of fungi. This fact does not of course militate against the fossil being a fungus, but if comparison be made between it and the burrows of various living insects, the resemblance is most marked. Some of these are shown in the figures given on the following page (figs. 2 and 3).

The burrows, although more or less constant in form for each individual species, present great variations. With a sufficiently large series of examples it might be possible to find some presenting a greater resemblance to the fossil, but the general aspect of the modern insect mines is sufficient to induce the belief that the supposed fossil is not a fungus but an insect burrow. This fact is rendered the more probable when it is remembered that remains of insects are found in the same beds as those containing the fossil *Rhizomorpha*.

* Proc. Am. Phil. Soc., Phila., Vol. XVII, 1887, pp. 173–175.

† Remarks on a supposed fossil fungus from the Coal Measures. Jour. Cin. Soc. Nat. Hist., Vol. VIII, 1885, pp. 157–159.

Another fossil described as a fungus was later on shown not to be such. It was originally named by Goeppert *Gyromyces ammonius*. It

FIG. 2.—Larval burrow of *Bostrychus typographus*. Nat. size. (After Hess.)

was found in Saxony under the bark of certain coal plants and subsequently in rocks of Carboniferous age in North America. It has been shown by Dawson to be really the spiral tube of an annelid, and was

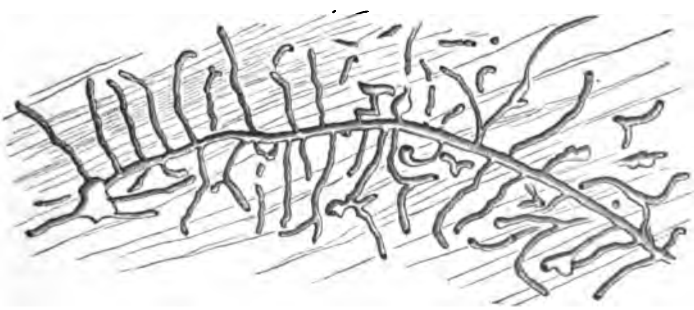


FIG. 3.—Burrow of *Carphoborus bifurcus*. Nat. size. (After Packard.)

named by him *Spirorbis carbonarius*. Lesquereux also considered the fossil to belong to the animal kingdom and figured it as such in volume 2 of the Geological Survey of Illinois, 1866 (p. 462, pl. 38, fig. 6).

DESCRIPTIONS OF SOME NEW SPECIES OF FUNGI.

By J. B. Ellis.

PODAXON MEXICANUM *n. sp.*—On the ground in a garden, near the bay, at Ajia Bampo, Sonora, Mexico, November, 1890. (Dr. Edward Palmer.) Whole plant, 4–8^{cm} high. Stipe about 1^{cm} thick at the base, tapering above and running through to the vertex of the peridium; subbulbous, hollow, the cavity at first filled with silky fibers. Flesh white, except at the point where it enters the peridium, where it is of a bright orange color (within). Peridium ovate, 2–3½^{cm} high, 2–3^{cm} wide, thin, white, and like the stipe clothed with broad, yellowish, appressed scales, attached to the stipe below at first, then separating, with the margin laterate-sublobate. Capillitium attached to the stipe or to the inner surface of the peridium, consisting of branching, yellowish threads 3–8μ in diameter, with abundant yellowish olive globose or ovate, 8–12μ spores, with some larger (12–15μ) ones intermixed.

UROMYCES RHYNCOSPORÆ *n. sp.*—On *Rhyncospora glomerata*. Pennsville, Salem County, N. J., October, 1881. (A. Commons.) I and II not seen. (III.) Sori hypophyllous, scattered or aggregated and subconfluent, orbicular or subelongated, ½–1^{mm} in diameter, black, naked, and loosely embraced by the margin of the ruptured epidermis. Teleutospores clavate, 20–25 by 8–12μ, strongly thickened and darker colored at the apex, which is generally at first prolonged into a beak 10–12μ long, making the spore lanceolate; sometimes this beak is permanent, but oftener the spore becomes obtuse or even squarely or obliquely truncate. Pedicels 20–25μ long, subequal or slightly thickened at the base, hyaline or yellowish. This species is different from *Uromyces caricis* Peck. [Which has been shown by Dietel, in *Hedwigia*, vol. 28, p. 22, to be the uredo of *Puccinia caricis-strictæ* Dietel.—ED.]

PUCCINIA MICROICA *n. sp.*—On *Sanicula* (?). Garrett Park, Md., May, 1890. (E. A. Southworth.) Æcidia hypophyllous, crowded on slightly thickened suborbicular spots 1½–2^{mm} across, papilliform and closed at first, then open, shallow, cup-shaped, ¼^{mm} in diameter, with a narrow granular-stellate, evanescent border. Spores orange, subglobose 15–22μ, or more or less irregular. Uredospores in the same sori with the teleutospores, not abundant, subglobose, pale, faintly aculeolate, 18–22μ in diameter. Teleutospores in minute sphæriiform sori mixed with the æcidia, about ¼^{mm} in diameter, at first covered by the epidermis, then naked above and dark brown, mostly biconical (some of them oblong or elliptical). Slightly constricted, pale brown, with a small, prominent hyaline, central or oblique papilla at the apex, 25–45 by 14–20μ, with very short pedicels. Epispore smooth.

PUCCINIA MONTANENSIS *n. sp.*—On *Elymus condensatus*. Helena, Mont., July, 1891. (Rev. F. D. Kelsey). I and II not seen. (III.) Sori mostly linear, lying between the nerves of the leaf and often con-

luent for 1^{cm} or more long, so very abundant as to blacken the leaf, hypophyllous, black, at first covered by the epidermis, but soon bare, not prominent. Teleutospores ovate or elliptical, 25–50 by 15–22μ, sessile or nearly so, moderately constricted at the septum, apex rounded or flattened, sometimes obliquely flattened, strongly thickened, but not papillate, darker colored and mostly shorter and broader than in *P. rubigo-vera.* The sori are mostly surrounded by paraphyses. The habit also is different.

PUCCINIA SUBCOLLAPSA *n. sp.*—On leaves and stems of some plant of the order *Asclepiadaceæ*, collected in South America by Thomas H. Morong. (Communicated by Mrs. E. G. Britton.) (III.) Sori amphigenous, hemispherical, chestnut-colored, $\frac{1}{3}$–$\frac{1}{2}^{mm}$ in diameter, thickly and quite evenly scattered over the leaves and stems. Teleutospores ovate, elliptical or subglobose, 18–22 by 12–15μ, slightly constricted in the middle, pale brown. Epispore thin and smooth, often collapsing at the apex and sometimes also at the base, causing the two cells to appear as if pressed together and giving the spore a subcubical shape. Pedicels slender, about 60–75μ long, attenuated below and hyaline, slightly colored above. Some of the spores are without septa. Differs from *P. heterospora* B. & C. in habit and in its thin-walled, after collapsed teleutospores.

UREDO ERIOCOMÆ *n. sp.*—On leaves of *Eriocoma cæspitosa.* Mohave Desert, Kern County, Cal., May, 1892. (D. W. Coquillett.) Sori hypophyllous, oblong, 1–4^{mm} long, pulvinate, soon naked, dark chestnut color. Uredospores globose, 20–25μ in diameter, or ovate 22–30 by 20–25μ, hyaline at first, soon becoming chestnut brown. Epispore thick, nearly equally so all round, short tubercular-spinulose; pedicels short, equal, hyaline. Differs from *U. bouteloucæ* Arthur in the absence of any spots, the larger sori, and equally thickened epispore.

UREDO SIMILIS *n. sp.*—On leaves of *Lycium vulgare.* Brookfield, Ind., November, 1890. (E. M. Fisher, No. 417.) Sori amphigenous, orbicular, $\frac{1}{2}^{mm}$ in diameter, yellow, becoming pale brown, scattered, flattened, not on spots. Spores obovate, 22–35 by 15–20μ, rounded and slightly thickened and aculeate above, narrowed and smooth below, hyaline, becoming yellow. Pedicels very short. Differs from the *Uredo* of *Puccinia lycii* Kalch. in the absence of any spots and in its larger, obovate spores. *P. afra* Winter has uredospores aculeate above and smooth below, but oblong and larger. *P. tumidipes* Pk. also has larger uredospores aculeate at both ends. Possibly our Uredo may prove to belong to *Puccinia globosipes* Pk., of which the uredoform is as yet unknown.

TILLETIA RUGISPORA *n. sp.*—In ovaries of *Paspalum plicatulum.* College Station, Brazos County, Tex., 1889. (T. L. Brunk.) Mass of spores snuff-gray, filling the ovaries. Spores globose, rather pale brown, 15–22μ in diameter, tuberculose-reticulate, the reticulations about 1μ high and $1\frac{1}{2}\mu$ broad. The affected ovaries are scarcely changed in outward appearance.

ASTERNIA RADIANS *n. sp.*—On living leaves of *Capparis cynophallophora*. Florida, 1891. (No. 256, Simpson's collection.) Perithecia hemispherical, black, rough, with a black, shiny, compressed or subpyramidal ostiolum, finally collapsing slightly above; about $\frac{1}{4}^{mm}$ in diameter; hemispherical; densely crowded and radiately arranged in orbicular patches 3–4^{mm} in diameter on the upper side of the leaf. Asci elliptical, briefly stipitate, 35 by 20μ, distinctly paraphysate, paraphyses slightly thickened at the apex. Sporidia 8 in an ascus, ovate, 12–15 by 5–5½μ, uniseptate, slightly constricted at the septum, yellowish hyaline, becoming brown.

ACANTHOSTIGMA FRAXINI *n. sp.*—On leaves of living *Fraxinus americana*. Near Washington, D. C., August, 1889. (M. B. Waite.) Perithecia epiphyllous, scattered, superficial, black, sub-hemispherical, about 150μ in diameter, of parenchymatous texture (astomous?), covered with short, black, scattering, spreading bristles 30–40 by 4μ. Asci subovate, about 35 by 15μ, short-stipitate 4 (–8)? spored. Sporidia (as far as seen) 4 in an ascus, clavate, 3–4-septate, 25–30 by 4–5μ, deeply constricted at the septa, yellowish or greenish hyaline. The upper cell of the sporidium is elliptical and broader and shorter than those below. The leaf is mottled with reddish brown spots and the perithecia are scattered alike over these spots and over the green parts of the leaf.

CONIOTHYRIUM MUSCICOLUM *n. sp.*—On capsules of *Polytrichum*. Carlin, Va., August, 1892. Perithecia lenticular, membranaceous, black, astomous, 75–90μ in diameter, covered by the thin epidermis, through which it is distinctly visible. Sporules globose, yellow brown, 8–10μ. This resembles outwardly *Stagonospora rauii* Ell. on the same host, but the sporules are very different.

STAGONOSPORA BACCHARIDIS *n. sp.*—On living leaves of *Baccharis*. Virginia Beach, Va., under pine trees, May 28, 1891. (W. T. Swingle.) Epiphyllous. Perithecia superficial or nearly so, hemispherical, 110–120μ in diameter, broadly perforated above, black, of tolerably coarse cellular texture. Conidia broad-fusoid, yellowish hyaline, 2-septate, nearly straight, 25–30 by 6–7μ, arising directly from the cells of the proligenous layer, with no perceptible basidia.

SEPTORIA AMPELOPSIDIS *n. sp.*—On leaves of *Ampelopsis quinquefolia*. Oregon, Ill., September 14, 1889. (M. B. Waite.) Spots numerous, angular or otherwise irregular, limited by the veinlets of the leaf, subconfluent, greenish at first, becoming dark brown, occupying the greater part of the leaf, which becomes mottled with yellow. Perithecia buried in the parenchyma of the leaf, but prominent on both surfaces, subglobose, 80–100μ in diameter, perforated. Sporules vermiform or clavate-cylindrical, hyaline, 30–50 by 3–3½μ, 4–8-septate. This approaches *Cylindrosporium* on account of the imperfectly developed perithecia.

SEPTORIA MICROSPORA *n. sp.*—On leaves of *Asprella hystrix*. Crawfordsville, Ind., August, 1890. (E. M. Fisher, No. 101.) Perithecia

innate, small, about 30μ in diameter, visible on both sides of the leaf, but more prominent and mostly opening on the upper side, pale, seated on rusty yellowish or reddish brown, elongated, narrow, subconfluent spots. Sporules cylindrical, continuous, 6–12 by 1–1¼μ. The leaves finally become rusty brown and dead, especially at the points.

SEPTORIA LEUCOSTOMA *n. sp.*—On living leaves of *Fraxinus americana.* Urmeyville, Ind., August, 1890. (E. M. Fisher, No. 136.) Spots reddish brown, irregular in shape, 1¼–½^{cm} in diameter, or by confluence occupying a large part of the leaf, surrounded by a yellow, shaded border about the same on both sides of the leaf. Perithecia scattered on the spots, large, 200–230μ in diameter, lenticular, amphigenous, but more prominent on the upper side of the leaf, pierced with a large, round, white-margined opening above. Sporidia fusoid, mostly strongly curved, nucleate, becoming about 3-pseudoseptate, 20–30 by 2½μ. Seems to differ from *S. elæospora* Sacc. in its much larger perithecia and strongly curved sporidia.

SEPTORIA PIMPINELLÆ *n. sp.*—On leaves of *Pimpinella integerrima.* Winona, Minn., August, 1888. (J. M. Holzinger.) Perithecia amphigenous, scattered, not on any spots, erumpent, 120–130μ in diameter. Sporules short (15–20μ), curved, continuous, hyaline, about 1¼μ thick at the broader end, resembling the sporules of a *Phlyctæna.* Some of the perithecia contain short, oblong fusoid 2-nucleate sporules 6–9 by 2½μ, hyaline (*Phyllosticta* sp.). The *Septoria* has the sporules shorter than in any of the other described species on *Umbelliferæ.*

SEPTORIA RUMICIS *n. sp.*—On leaves of *Rumex* sp. Winona, Minn., August, 1888 (J. M. Holzinger), and Champaign, Ill., September, 1889. (M. B. Waite.) Spots amphigenous, grayish brown, becoming rusty brown and paler in the center, with a narrow, slightly raised border surrounded by a dark-shaded border while the leaf is fresh, 3–4^{mm} in diameter. Perithecia punctiform, brown, scarcely visible, buried in the substance of the leaf with only the minute apex showing, most distinct on the lower surface of the leaf, but also visible above. Sporules cylindrical, curved, obtuse, continuous, faintly nucleate, subequal, 15–25 by 1½–2μ.

PHLYCTÆNA ANDERSONI *n. sp.*—On dead stems of *Arabis holbœllii* and *Draba* sp. Sand Coulee, Cascade County, Mont., July, 1888. (F. W. Anderson.) Perithecia gregarious on pale spots, subcuticular, conic-globose, at length collapsing, raising the epidermis into little black pustules, having the aspect of a *Sphærella.* Sporules fusoid arcuate hyaline, acute at each end, continuous, 12–15 by 2½μ. Some of the pale spots on which the perithecia are seated are tinged with rose color.

CYLINDROSPORIUM STACHYDIS *n. sp.*—On *Stachys palustris.* Champaign, Ill., September, 1888. (M. B. Waite.) Spots amphigenous, small (1–2^{mm}) rusty brown, becoming nearly black, with a whitish center, subangular and tolerably well defined. Acervuli small, innate, slightly

prominent on the lower surface of the leaf. Conidia filiform, mostly curved, a little thicker at one end, subobtuse, hyaline, multinucleate, becoming multiseptate, 35–50 by 2μ, erumpent below and whitening the surface of the spots. This differs from the specimen of *Septoria stachydis* Rob. in Desm., Plantes Crypt., 1712, in its smaller, darker, more definitely limited spots, and its thicker, multinucleate conidia.

STILBOSPORA VARNEYANA *n. sp.*—On dead twigs. Grounds of the Department of Agriculture, Washington, D. C., September, 1891. (Collected by F. W. Anderson, communicated by May Varney.) Acervuli subcutaneous, subtuberculiform-prominent, conidia oblong-elliptical, 3-septate, not constricted, hyaline at first, soon becoming dark brown and opaque, except the terminal cells, which are small and remain subhyaline, 15–25 by 12–14μ. Differs from *S. angustata* Pers. in its smaller conidia, with the end cells hyaline.

TUBERCULINA SOLANICOLA *n. sp.*—On fruit of eggplant. Fla. (C. E. Smith.) Acervuli erumpent, tuberculiform, $\frac{1}{3}^{mm}$ in diameter, at first pale, becoming darker when dry, gregarious on pallid spots, 1^{cm} in diameter, or by confluence more. Basidia 12–15 by 2–2½μ, guttulate, hyaline, attenuated and slightly curved above. Conidia elliptical, 2-nucleate, hyaline, 5–7 by 2½–3μ. Differs from the other species of this genus in not being (so far as yet known) associated with any Uredinous fungus.

FUNGI DESCRIBED IN RECENT REPORTS OF THE CONNECTICUT EXPERIMENT STATION.

By ROLAND THAXTER.

In the reports of the Connecticut Station for 1889–'91 the writer had occasion to publish descriptions of certain new species of fungi which it seems desirable to duplicate in a form more permanent and readily accessible than that afforded by the somewhat evanescent Experiment Station literature, and through the courtesy of the editor of the JOURNAL the descriptions in question are appended, with a few additional notes.

UROCYSTIS HYPOXYIS Thaxter.

Ann. Rep't. Conn. Agr. Exp. Sta. in descr. of Pl. II, following p. 153: Pl. II, Figs. 12–14, New Haven, April, 1890. Ellis N. A. F., Cent. XXVII, No. 2688. Sacc. Syll., Vol. IX, p. 290. Pazschke, Hedwigia, 1892, p. 94.

Spore masses black, in flowers (filling ovary), pedicels, and peduncles (only near summit). Spore balls very irregular in size and shape, roundish or long oblong, the largest 50–60 by 50μ, the smallest about 25 by 25μ. Resting spores brown, spherical or somewhat polygonal from pressure, one to ten, rarely 14 to 15 in number, 13–15μ. Pseudospores numerous, and when the resting spore is single about 8 to 10 in number, somewhat flattened, variable, 8–15μ in diameter. On *Hypoxys erecta* L. June–Aug., Westville, Conn.

ɪis species occurred abundantly in a single locality near New en, but has not been found elsewhere in this country. Specimens ɩ Brazil, however, which seem to be identical with the Connecticut ɩ, have since been received from Dr. Otto Pazschke. Since the er's original spelling of the specific name (*hypoxys*) has been set e in favor of *hypoxydis* by Saccardo and others who have had occa- to mention it, some pains have been taken to ascertain from class- authorities, both at New Haven and at Cambridge, exactly what the ling of such a genitive should be. Although the authorities in ques- were unanimous in asserting that *hypoxydis* (or *hypoxidis*) was abso- ly incorrect the unanimity in regard to what spelling is really cor- was not so striking. The general opinion seems to prevail, how- r, that such a genitive, had it been used, would have had the termi- ion *yis*, and *hypoxyis* may therefore be safely employed to designate present form.

PHYTOPHTHORA PHASEOLI Thaxter.

Gazette, Vol. XIV, 1889, p. 273; Ann. Rep't. Conn. Agr. Exp. Sta., 1889, p. 7, Pl. III, figs. 29–37; Seymour & Earle Econ. Fungi. No. 9. Ellis N. A. F., ɜnt. XXVIII, No. 2707.

ycelial hyphæ branched, rarely penetrating the cells of the host by irregular storia. Conidiophores slightly swollen at their point of exit through the stomata, ing singly or two to several in a cluster; simple or once dichotomously branched, once to several times successively inflated below their apices. Conidia oval or ptical, with truncate base and papillate apex; 35–50 by 20–24μ. Germination by spores, usually fifteen in number, or rarely by a simple hypha of germination. pores unknown. On pods, stems, and leaves of the Lima bean (*Phaseolus lunatus*). t. and Oct., New Haven, Conn.,

Although so common about New Haven this species has not, so far the writer is aware, been observed in any other locality. Whether is an introduced exotic or is a native form which may yet be found some native leguminous plant, is uncertain; yet its introduction at ɜw Haven may possibly be traced to the fact that a gentleman resi- nt there, in whose garden the fungus was abundant, received a ckage of Lima beans directly from South America some years since, nich, when planted, may have originated the epidemic which all the rdeners whom the writer questioned concerning it, agreed to be of mparatively recent origin. The species is mentioned by Fischer in s Phycomycetes (*Rabh. Kryptogamenfl.* Vol. I. part 4, p. 415) as an ungenau bekannte Art;" why "ungenau" is hardly evident from the ferences above quoted.

GYMNOSPORANGIUM NIDUS-AVIS Thaxter.

ull. No. 107, Conn. Agr. Exp. Sta., p. 6; also Ann. Rep't of same for 1891, p. 164. Seymour & Earle, Economic Fungi, Nos. 239 & 240.

Sporiferous masses when young, cushion-like, irregularly globose or oval, small nd distinct or elongate and confluent according to the habitat; rich red brown; hen mature indefinitely expanded by moisture, orange-colored. Teleutospores

two-celled, irregular in shape, broadly ovate to subelliptical or fusiform, blu... rounded or slightly tapering toward the apex, symmetrical or often slightly ... Average dimensions 55 by 25μ. Promycelia several, not uncommonly proce... from either extremity. Pedicels when young often more or less inflated below ... spore. Mycelium perennial in leaves, branches, or trunks of *Juniperus virginia...* very commonly inducing a "bird's-nest" distortion.

Ræstelia stage.—Spermogonia yellowish orange, preceding the æcidia by abou... days. Æcidia hypophyllous or more commonly on petioles and young shoots, ... especially on young fruit, densely clustered, brown, at first subulate, then fimbr... the peridia splitting to the base, with its divisions slightly divergent. Peridial ... rather slender, the ridges somewhat prominent, sublabyrinthiform, horizontal or b... coming inwardly oblique towards the extremities. Average measurements (tow... the apex of the peridia) 7 by 18μ. Æcidiospores smooth, spherical or irregular, oval to oblong; average diameter 25μ.

Mycelium annual in the leaves of *Cydonia* (quince) and in leaves, stems, and fr... of *Amelanchier canadensis* (service berry) in June.

OOSPORA SCABIES Thaxter.

Ann. Rep't. Conn. Agr. Exp. Sta., 1891, p. 159.

Vegetative hyphæ hyaline or brownish from the general discoloration of the su... stratum, .4–.6μ, rarely as much as 1μ in diameter, curving irregularly, septate or pse... doseptate, branching. Aërial hyphæ at first white, then grayish, evanescent, bre... ing up into bacteria-like segments after producing terminal spirillum-like "spore... by the coiling of their free extremities. Forming a firm, lichenoid pellicle o... nutrient jelly, and usually when growing in contact with the air producing a d... black-brown discoloration of the substratum. Producing the disease known as "Scab" on potato tubers and a similar affection of beet roots.

The measurements of the hyphæ of this form given in the origin... description (.6–1μ) are somewhat larger than they should be, hyphæ 1... in diameter being very rarely seen and the average diameter bein... usually less than .6μ. The spiral forms are most readily seen in th... grayish film developed naturally on the scab spots, though they are ob... tained without difficulty from the aërial hyphæ on hard agar cultures. The writer has seen no published account of further European obser... vations upon the disease, and such accounts are to be awaited with in... terest. Sauvageau,* however, has apparently obtained the scab fungus accidentally from water, and described it as *Oospora metchnikowi* n. s. Although this writer does not mention the spiral "spores" the form corresponds so closely to the present species, both in structure and ... its effects upon the substratum, that the identity of the two seems more than probable.

* Ann. d. l'Inst. Pasteur, t. VI, p. 242.

ESCRIPTIONS OF NEW SPECIES OF PUCCINIA AND UROMYCES.

By S. M. Tracy.

PUCCINIA ARISTIDÆ *n. sp.*—(II, III). Rarely amphigenous, usually n the inside of the sheath. Sori oval to narrowly elliptical, sometimes onfluent, ruptured epidermis prominent. Uredospores brownish yel-w, subglobose or oval, epispore thick, minutely tuberculate, 23–27 by -32μ. Teleutospores light brown, broadly oval, slightly constricted, pispore smooth, thickened at the apex, 25–28 by 40–45μ. Pedicel ightly tinted, tapering, about twice the length of the spore. On *ristida pungens*; herb. *A. Regel*, Turkestan, 1887.

PUCCINIA PALLIDA *n. sp.*—(III). Hypophyllous. Sori small, dark, attered. Teleutospores light-colored, clavate, constricted, apex very uch thickened and rounded, or somewhat pointed, 12–14 by 42–52μ. edicel very short, almost wanting. On *Osmorrhiza*. Platteville, Wis., ctober, 1887.

PUCCINIA REDFIELDIÆ *n. sp.*—(III). Sori oval, sometimes becom-g linear by confluence, black. Teleutospores dark brown, broadly lliptical or oval, constricted, epispore smooth, thickened at the apex, -26 by 40–45μ. Pedicel tinted, rather large, twice to three times the ngth of the spore. On *Redfieldia flexuosa*. Dr. George Vasey, Kansas, 889.

UROMYCES ANDROPOGONIS *n. sp.*—(II, III). Hypophyllous. Sori oval r oblong, sometimes confluent. Uredospores light colored, subglobose, harply echinulate, 15–17 by 16–19μ. Teleutospores dark brown, broadly val, apex obtuse, rounded, strongly thickened, 14–16 by 24–28μ. 'edicel somewhat tinted, twice the length of the spore. On *Andropogon irginicus*. Starkville, Miss , October, 1891.

UROMYCES ERAGROSTIDIS *n. sp.*—(II, III). Amphigenous. Sori inute, scattered, long, covered with the epidermis. Uredospores light 'ellow, subglobose, echinulate 16–18 by 17–20μ. Teleutospores usually val or obovate, often angular, epispore smooth, thickened at the apex, 4–16 by 22–28μ. Pedicel slightly tinted, as long as the spore. On *Eragrostis pectinacea*. Starkville, Miss., October, 1891.

UROMYCES PANICI *n. sp.*—(II, III). Hypophyllous. Sori oval or ob-ong, sometimes becoming confluent. Uredospores light yellow, faintly chinulate, globose, 12–16μ. Teleutospores dark brown, oval, smooth, pex thickened and sometimes beak-like, 14–16 by 26–30μ. Pedicel apering, tinted, somewhat longer than the spore. On *Panicum anceps*. [. M. White, Martin, Miss., September, 1891.

UROMYCES HORDEI *n. sp.*—(III). Hypophyllous. Sori minute, scat-ered, round or oval. Teleutospores brown, quite irregular, but usually val or broadly clavate, epispore smooth, slightly thickened above, 15–18 by 22–26μ. Pedicel very short. On *Hordeum pratense*, New Orleans, La., May, 1891.

REVIEWS OF RECENT LITERATURE.

(1) ZOPF, DR. WILHELM.—*Die Pilze in morphologischer, physiologi biologischer und systematischer Beziehung.* Breslau, 1890, pp. 500, figs. 163. Eduard Trewendt.

(2) KIRCHNER, DR. OSKAR.—*Die Krankheiten und Beschädigungen serer landwirtschaftlichen Kulturpflanzen.* Eine Anleitung zu i Erkennung und Bekämpfung für Landwirte, Gärtner, etc. Stu gart, 1890, pp. x, 637. Eugene Ulmer.

(1) The frequent use of this book for more than a year and recent careful reading of the whole of it preparatory to this review. ha served to strengthen the first impression, viz, that for the gen student it is the best handbook yet published. We miss through it is true, De Bary's classical style, and in places also his intim knowledge and comprehensive grasp of details, but on the other ha there is a welcome absence of interminable minutiæ, and a certain dir ness and subordination of the parts to the whole that more than co pensates. Naturally our first thought is to compare the book wi De Bary's *Morphologie*, but the two occupy different fields. De Bar concerns himself almost exclusively with structure, delighting in wealth of detail, very useful to the specialist, but always very disco aging to the general student, especially if to the perplexities of the sub ject are added a condensed style and the difficulties of a foreign la guage, in this case now happily overcome for English readers by Ga sey's translation.

As the title indicates, this work is an effort to cover the whole groun of morphological, physiological, and systematic mycology and, consi ering the difficult nature of the task, it must be said that Dr. Zopf ha succeeded admirably.

The preface is dated Halle a. S., May, 1890, and the book is del cated "*Dem Andenken von* E. Fries, Tulasne, De Bary."

The book is divided into six chapters, and perhaps no better ide can be given of the scope of the work than to translate the ru ning heads of the chapters devoted to morphology, physiology, an biology.

Chapter I, in 27 pages discusses *The morphology of the vegetati organs:* Typical mycelium—sprout mycelium—haustoria—climbing m celium—sclerotia—mycelial strands and pellicles—reduced myceli

Chapter II, in 68 pages, discusses *The organs of fructificati* Exosporous or conidial fructification, nature of conidia and mode of mation—forms of conidial organs—simple conidiophores—coni bundles—conidia beds—conidia fruits; endosporous or sporang fructification—simple sporangiophores—sporangial beds—sporang fruits—structure of the mature ascus fruit—development of the sp angial fruits; zygosporous fructification; gemma (brood cells, chla

dospores); monomorphism, dimorphism, pleomorphism; *Mechanical arrangements for liberating the spores:* The loosening of the conidia from each other and from their supports—the expulsion of conidia, sporangia, and fruit-forming organs—the liberation of endospores from the sporangia of the Phycomycetes—the ejaculation of spores from asci—liberation of conidia from pycnidia—liberation of ascospores from the non-ejaculatory Ascomycetes.

Chapter III, in 20 pages, treats of *Cell structure:* The membrane thickenings—foldings—differentiations—chemical nature—physical nature; plasma; cell division. *Cell formation:* Free cell formation; cell division. *Union of cells into systems (tissues):* Cell threads—cell surfaces—cell masses—hyphal tissues—fusion formation (fusion tissue).

Chapter IV, in 109 pages, treats of *The Chemical composition:* Inorganic; organic—carbohydrates—vegetable acids—aromatic acids (tannins, acids of lichens)—fats—ætherial oils—resins—colors (yellow or yellow-red oleaginous colors, *i. e.*, lipochrome)—colors not due to lipochrome—reds—greens—blues and blue greens—violets—browns—combinations with each other and with other substances—the distribution of particular colors—change of color—glycosides—plant bases (alkaloides)—cholesterin—albumen. *Foods:* Inorganic—organic - composition and combinations—chemical reactions. *Transformation, storage, secretion:* Ferments (enzymes)—inverting—starch dissolving—paramylum dissolving—cellulose dissolving—peptonizing—fat splitting—chitin dissolving; resin-like bodies and ætherial oils; colors and chromogenes; secretion of albumen and peptone; secretion of sugar; oxalic acid; other acids; ammonia; water. Respiration; fermentation (splitting—oxidation); splitting up of food materials; production of heat; production of light. *Influence of external forces on growth, fructification, etc.:* Light—temperature—mechanical movement—atmospheric pressure. *Phenomena of movement:* Heliotropism—hydrotropism—geotropism—movements due to contact—rheotropism—chemical irritation—electrical irritation—nutation—hygroscopic movements. *Life activity and life injuring agents:* Extremes of temperature—removal of water—insolation—poisons. *Mechanical means of killing or hindering development.*

Chapter V, in 57 pages, treats of the *Biology of fungi*, under the following heads: *Saprophytes*; *Parasites:* The transportation of infectious fungus germs; means and way of infection; choice of host—choice of organ; effect of parasitism in plants and animals—hypertrophy—metamorphosis—production of new growths—pseudomorphosis and mummification—destructive action; a glance at the diseases of men and animals due to fungi—invertebrates, vertebrates—fishes—birds—mammals—man; battle of the animal cells and tissues with the penetrated fungous cells. *Symbiosis:* The enemies of fungi—enemies of molds—of Saprolegniaceæ—of rust fungi—of Hyphomycetes—of Ascomycetes. *Duration of life.*

The reader who wishes a digest of what was known up to 1890 on any of these subjects can not do better than to consult this book, for if he does not there find all he needs the chances are that the foot-note references to the literature of the subject will put him in the way of finding the rest.

The last half of the book is devoted to a presentation of the systematic side of mycology. An account is given of each of the groups, and this is followed by a description of some of the more important genera. Naturally views differ as to classification. The most radical change, and one which will probably not meet with general acceptance, is the exclusion of *Synchytrium*, *Woronina*, *Olpidiopsis*, *Rozella*, etc., on the ground that the production of a vegetative plasmodium is entirely foreign to the eu-mycetes, and allies these organisms to the Myxomycetes and other forms which the author follows De Bary in considering to be animals.

The groups and families in Dr. Zopf's classification are arranged as follows:

I. PHYCOMYCETES.
- 1. Chytridiaceæ.
  - (1) Olpidiaceæ.
  - (2) Rhyzidiaceæ.
  - (3) Chladochytriaceæ.
- 2. Oomycetes.
  - (1) Saprolegniaceæ.
  - (2) Ancylistieæ.
  - (3) Peronosporeæ.
- 3. Zygomycetes.
  - (1) Mucoraceæ.
  - (2) Chætocladiaceæ.
  - (3) Piptocephalideæ.
  - (4) Entomophthoreæ.

II. MYCOMYCETES.
- 1. Basidiomycetes.
  - (1) Protobasidiomycetes.
    - (*a*) Pilacreæ.
    - (*b*) Auriculariaceæ.
    - (*c*) Tremellaceæ.
    - (*d*) Dacryomycetes.
  - (2) Hymenomycetes.
    - (*a*) Hypochnaceæ.
    - (*b*) Thelephoraceæ.
    - (*c*) Clavarieæ.
    - (*d*) Hydnaceæ.
    - (*e*) Polyporaceæ.

(MYCOMYCETES—continued).
    - (*f*) Agaricaceæ.
  - (3) Gasteromycetes.
    - (*a*) Hymenogastreæ.
    - (*b*) Sclerodermieæ.
    - (*c*) Lycoperdaceæ.
    - (*d*) Nidulariaceæ.
- 2. UREDINEÆ.
- 3. USTILAGINEÆ.
- 4. ASCOMYCETES.
  - (1) Gymnoascaceæ.
    - (*a*) Saccharomycetes.
    - (*b*) Exoasceæ.
    - (*c*) Gymnoasceæ.
  - (2) Perisporiaceæ.
    - (*a*) Erysipheæ.
    - (*b*) Aspergilleæ.
    - (*c*) Tuberaceæ.
  - (3) Sphæriaceæ.
    - (*a*) Sphæriaeæ.
    - (*b*) Hypocreaeæ.
    - (*c*) Xylarieæ.
    - (*d*) Hysteriaeæ.
  - (4) Discomycetes.
    - (*a*) Pezizaceæ.
    - (*b*) Helvellaceæ.

The author differs from Brefeld in keeping Gymnoascus among the Gymnoasceæ; from Rehm in classing Hysteriaeæ under Sphæriaceæ; from Fischer and most of the recent systematists in including Plasmopara, etc., under Peronospora; and from Schröter in excluding Myxomycetes, etc., on the grounds already stated.

The appendix is devoted to an interesting account of the following ıngi imperfecti:–*Torula*, *Mycoderma cerevisiæ*, *Monilia candida*, *M. ˡbicans*, *Dematium pullulans*, *Oidium schœnleinii*, *O. quinckeanum*, *O. ˈnsurans*, *Hormodendron cladosporioides*, *Cladosporium herbarum*, *Sepˈsporium bifurcum*, *Stachybotrys atra*, and *Arthrobotrys oligospora*. The ook concludes with a list of errata (by no means complete), a list of lustrations, and a general index. It is printed in clear Roman type, n good paper, and except for the half-paper cover, which does not 'ear well, is, like most German books, well bound. The illustrations re especially praiseworthy, not so much for mechanical execution, 'herein some are inferior, as for the care with which they have been elected to illustrate particular features, and the fact that most of iem have not been hackneyed by repeated use in other books. The lustrations are also numerous enough, by the union of many distinct gures into one so-called figure, to give a good general notion of the 'hole subject of fungi.

In several cases there is an omission of important facts which should ppear in a work of this charatcer, *e. g.*, Jensen hot water treatient for smut of oats and wheat, or Humphrey's discovery of cilia on he swarm spores of *Achlya*. Occasionally also there is a slip, *e. g.*, n page 90 the term "*epiplasm*" is attributed to De Bary with a diferent meaning from that given in his Morphologie, *i. e.*, De Bary uses t for glycogen mass, but it is here used to designate the residual prooplasm in free cell formation, for which De Bary's own term is "*periılasm*;" on pp. 386 and 397 the genus *Endophyllum* is said to possess ıo teleutospores, but to have æcidiospores which germinate with the ormation of a promycelium and sporidia, all of which might have come rom a superficial consideration of the arrangement of the spores or rom a hasty reading of Winter's description (Pilze I. p. 251), but which can scarcely be admitted if we are to attach any definite meaning to the term *teleutospore*; on p. 439 *Gymnoascus reesii* is said to be the only species of the genus, whereas Winter gives 3 and Saccardo 6. Such causes for complaint are, however, comparatively few, the bulk of the errors consisting of transpositions, slight omissions, incorrect numbering of descriptions (*e. g.*, fig. 74), and wrong cross-references. Of the latter there are at least a hundred, a very considerable number for a book of reference. Happily, so far as observed, these mistakes do not extend to the index, or the references to literature which are quite copious. This book was evidently first issued as part of a larger work of some sort (*Schenck's Handbuch?*) and then repaged for issue in the present form, and the errors are probably attributable to want of care in the revision.

The treatment of the whole subject of conidia and of the special group *Saccharomycetes* is of particular interest, but to readers already familiar with De Bary, the chapters devoted to physiology and biology will no doubt seem freshest, while to the beginner the 200 pages devoted to

classification must prove invaluable and alone worth many times the price of the book. So far as known to the writer, there is no other book in any modern language in which the student just commencing the study of fungi can find so good a résumé of what is absolutely essential for him to know. If he masters this one book he will have laid an excellent foundation for future studies of special monographs, and of that vaster book never to be included in any monograph.

(2) Dr. Kirchner's book occupies an entirely different field from the preceding. The plan is also quite unlike that followed in the handbooks of Frank and Sorauer. In fact the book is unique in the literature of plant diseases. In his preface the author regrets that knowledge of plant diseases and injuries is so little diffused among practical men, the very class who need it, and ascribes this in part to the fact that their study leads at once into the most difficult departments of two sciences, botany and zoölogy, and requires more time and more special knowledge than is at their command.

By keeping constantly in view the needs of farmers and gardeners, the author has succeeded in overcoming many of the difficulties and making a very practical, useful book. Theoretical considerations and technical expressions are excluded as far as possible, and a commendable effort has been made to combine simplicity with perspicuity and accuracy. In a book of this character it is of course impossible to avoid errors, and some have crept in, but there are not enough to seriously injure its usefulness. No claim is made to completeness, but nevertheless a great amount of interesting and valuable information has been well digested and put together in a very accessible form, and the general accuracy of statement is especially commendable. It is a book to save the busy man's time by answering as quickly as possible the following questions: (1) What ails the plant? (2) How can the trouble be remedied? The author has not confined himself to prominent diseases or to those due solely to vegetable parasites, but has made a praiseworthy effort to mention all, and the reader is therefore likely to find a paragraph touching any disease or injury on which he may wish enlightenment, provided, of course, it is one that occurs in middle or northern Europe.

The book is divided into two parts, the first 368 pages being an artificial key to the diseases and injuries of agricultural plants, arranged under the following heads: Cereals 14, edible Leguminosæ 6, grasses 20+, forage plants 25+, roots 4, commercial plants 12, vegetables and kitchen plants 27, fruit trees 11, berries 6, and the vine 1—total 126. The diseases attacking these 126 plants are classified according to gross appearances and according to the parts they attack. For example, 17 pages are devoted to the diseases of *Vitis vinifera*, arranged in the following way: I. Diseases and injuries of the leaves, II. diseases and injuries of the buds and shoots, III. diseases and injuries of the branches, IV. diseases and injuries of the old wood, V. diseases

and injuries of the roots, VI. diseases and injuries of the flowers and flower buds, VII. diseases and injuries of the berries. Under each of these groups are as many lettered or numbered divisions and subdivisions as may be necessary to include all of the diseases, one paragraph being given to each, with a numeral cross-reference to Part II, where a scientific description of the parasite may be found. When possible, classification is carried still farther, *e. g.*, under VII. diseases and injuries of the berries, the following subdivisions are given:

A. Rot of the berries.
 a–e.—Five paragraphs devoted to as many diseases.
B. Spots which hinder development, and sometimes completely destroy the berry, caused by fungi, which also occur on the leaves.
 a–g.—Seven paragraphs.
C. Spots of varied color which do not noticeably affect the growth and ripening of the berries.
 a–d.—Four paragraphs.
D. Injuries by insects.
 a–d.—Four paragraphs.
E. Dwarfing, protrusion of seeds, etc.

In Part II, under the appropriate classes, groups, orders, and families, there is a concise description of 1,332 injurious species, 423 of which are parasitic plants, mostly fungi, the descriptions of which are drawn principally from Saccardo, Winter, and Schröter. These 1,332 species are numbered serially, corresponding to the cross-references in Part I. A concise account is also given of the classes, orders, families, and genera to which these species belong, so that this part of the book is really a very serviceable compendium of parasitic plants and animals.

On the whole, this is the best book extant for the rapid determination of unknown plant diseases, and will therefore be of much use to students. The book would have had a wider circle of readers and have been still more useful if the author had included shade trees and all cultivated plants. Notes on treatment are given wherever anything definite has been ascertained, but this is the weakest part. The book is provided with a table of contents, an index to names, and a special index to technical terms.—ERWIN F. SMITH.

RUST IN WHEAT.—Report of the proceedings of the conference, convened by invitation of the Minister for Agriculture (the Hon. Sidney Smith), and held in Sydney [New South Wales] on June 2, 3, 4, 5, and 8, 1891. Sydney, Charles Potter, government printer, 1891. Folio, pp. 56, pl. 1.

The subject of rust in wheat has of late years excited the liveliest interest in the Australian colonies. According to a statement of the Minister for Agriculture, the total loss from the disease amounts to about £2,000,000 annually, and naturally a desire is felt to find some way of combating it. During the year 1890 many experiments were carried on. Details of these are given in the report of the conference convened at Sydney in June, 1891, at which delegates from the four

colonies, Victoria, South Australia, Queensland, and New South Wales were present.

The subject was discussed in all its phases, but it is neither possible nor desirable to enter fully into all the details. In Victoria the effects of manuring, spraying, drainage, varieties of seed, etc., were all tried. The results were largely negative, except in one instance, in Gippsland, where spraying with a solution of sulphate of iron, 1 ounce to 1 gallon of water, seemed to not only prevent but to stop further growth of the rust. More experiments are considered necessary in this direction, however. A series of questions was also sent out to farmers in Victoria and the results of the answers may be summarized as follows: (1) Rust seldom appears, to an injurious extent, in two successive years; (2) it generally appears early in October or November, depending upon the variety planted; (3) early-sown and early-maturing varieties escape the rust best; (4) in Australia the rust does not seem to require a change of host, but passes its entire existence upon a single one; (5) rust seems to prevail usually in seasons of excessive rainfall, especially in October and November, appearing when close and muggy weather sets in; its spread is most rapid in calm, hot days and dewy, foggy nights; windy weather as a rule is unfavorable; (6) the kind of soil seems to have no effect on the disease; (7) rust-shriveled wheat when sown appears to produce as good a crop and one as free from rust as plump seed; (8) no variety is free from rust in a bad season, but some are more and others are less affected, some few being free from rust for several years in succession.

The following suggestions are made as to the best measures to lessen or prevent damage: (1) Maintain a high standard of health; (2) use all possible measures unfavorable to and avoid those favorable to rust; (3) remove exciting causes where possible, by burning stubble, destroying weeds, etc.; (4) obtain as far as practicable rust-proof varieties; (5) spray crop with some solution at critical stage.

Experiments in Queensland reported on by Mr. P. McLean were mainly negative, owing to the exceptionally favorable year. Rust-shriveled seed wheat, however, was found by fifty-five out of sixty farmers to give good results.

Answers to inquiries made by the Department of Agriculture of New South Wales did not differ materially from those already given. At the conclusion of the report, however, the writer, Dr. N. A. Cobb, referred to investigations he had made on the fungi causing rusts (*Puccinia rubigo-vera* and *P. graminis*), stating that nearly all the damage was caused by the former. He described the changes these fungi undergo in development, and said they are found all the year on either wheat or native grasses. He also called attention to the fact that the larvæ of a species of insect had been found feeding upon the rust spores, and that while in this way a certain number of spores were destroyed they were also widely distributed by adhering to hairs

covering the bodies of the insects. For prevention of the rust early sowing was advocated, and the belief was expressed that saccharate of copper would be useful in spraying for the disease.

This paper led to considerable discussion, especially in regard to the benefits of spraying. The general idea, however, was that if practicable this would be the best way of combating the disease. There was also considerable discussion over the matter of producing a rust-resisting variety of wheat, advocated by Wm. Farrer of New South Wales. Other reports were read and the conference finally submitted a report containing numerous recommendations. Among these were early sowing, cutting in the dough state except when to be used for seed, experimenting to obtain rust-proof varieties, the establishment of stations to distribute standard and desirable varieties, more extended use of red varieties in place of the white ones, rotation of crops, thin sowing, burning of diseased straw, experiments with spraying machines and fungicides, etc.

Incidentally, the disease known as "take-all" was discussed, the investigations of a commission of South Australia, in 1867 and 1868, being cited to prove that it is due to the presence of a minute animalcule which was called *Vibrio tritici* or eel of wheat. These animalculæ are harbored in a black deposit, a "lichen or moss," found between the roots and the first internode of the wheat plant. The disease works in patches, radiating in all directions from a center and destroys all cereals or native grasses in its course.

The conference, as a whole, may be regarded as a success. Views of diverse character were expressed by the delegates, and it is of course possible that what would apply in one colony would not in a distant one. Should the conference be instrumental in directing attention to methods for decreasing the amount of rust, and there is every reason for supposing that it will, its meeting will not have been in vain.—JOSEPH F. JAMES.

ERRATA TO INDEX TO LITERATURE.

The following numbers were purposely omitted from the last number of the OURNAL: 395, 401, 532, 537, 538, 547, 640, and 651.

The following corrections and additions should be made in the numbers of the NDEX:

No. 10. *Add* (see also Ex. Sta. Rec., Vol. II, April, 1891, pp. 481–482).
No. 34. *Add* (see also Ex. Sta. Rec., Vol. II, Sept., 1890, p. 49).
No. 40. *Add* (see also No. 104, and Ex. Sta. Rec., Vol. II, Sept., 1890, p. 63).
Nos. 42, 43. *Add* (see also Ex. Sta. Rec., Vol. II, Oct., 1890, p. 134).
No. 51. *Add* (see also Ex. Sta. Rec., Vol. III, Dec., 1891, p. 297).
No. 69. *Add* (see also Ex. Sta. Rec., Vol. II, Oct., 1890, pp. 104–105).
No. 73. July 21 *should be* July 2.
No. 105. *Add* (see also Ex. Sta. Rec., Vol. II, Aug., 1890, pp. 12–13).
No. 113. *Add* (see also Ex. Sta. Rec., Vol. II, Feb., 1891, p. 325).
No. 116. *Add* (see also Ex. Sta. Rec., Vol. II, Dec., 1890, p. 246).
No. 123. *Add* (see also Ex. Sta. Rec., Vol. II, July, 1891, pp. 713–716).
No. 135. *Add* (see also Ex. Sta. Rec., Vol. II, Dec., 1890, pp. 241–242).
No. 140. P. 141 *should be* p. 481.
No. 150. *Add* (see also Ex. Sta. Rec., Vol. II, Dec., 1890, p. 252).
No. 156. *Add* (see also Ex. Sta. Rec., Vol. II, Feb.,1891, pp. 342–343).
No. 157. *Add* (see also Ex. Sta. Rec., Vol. II, Dec., 1890, pp. 220–222).
No. 179. *Add* (see also Ex. Sta. Rec., Vol. II, April, 1891, pp. 508–509).
No. 192. *Add* (see also Ex. Sta. Rec., Vol. II, April, 1891, pp. 504–505).
No. 197. *Add* (see also Ex. Sta. Rec., Vol. II, March, 1891, p. 406).
No. 199. *Add* (see also Ex. Sta. Rec., Vol. II, March, 1891, pp. 416–417),
No. 209. *Add* (see also Ex. Sta. Rec., Vol. II, March, 1891, pp. 421–423).
No. 215. *Add* (see also Ex. Sta. Rec., Vol. II, March, 1891, pp. 408–410).
No. 238. *Add* (see also Ex. Sta. Rec., Vol. II, April, 1891, p. 490).
No. 241. *Add* (see also Ex. Sta. Rec., Vol. II, Jan., 1891, pp. 293–294).
No. 245. *Add* (see also Ex. Sta. Rec., Vol. II, June, 1891, pp. 637–638).
No. 246*a*. *Add* (see also Ex. Sta. Rec., Vol. III, Aug., 1891, pp. 7–8).
No. 254. *Add* (see also Ex. Sta. Rec., Vol. II, Aug., 1890, p. 25).
No. 270. *Add* (see also Ex. Sta. Rec., Vol. II, April, 1891, p. 501).
Nos. 276 to 287, inclusive. *Add* (see also Ex. Sta. Rec., Vol. III, Oct., 1891, pp. 160–161).
No. 291. *Add* (see also Ex. Sta. Rec., Vol. II, June, 1891, pp. 638–641).
No. 295. *Should read* McC[arthy], G[erald]. Also pp. 156–158 *should be* 155–156.
No. 310. *Add* (see also Ex. Sta. Rec., Vol. II, July, 1891, pp. 711–712).
Nos. 311 to 326, inclusive. *Add* (see also Ex. Sta. Rec., Vol. III, Aug., 1891, pp. 9–11).
No. 327. *Add* (see also Ex. Sta. Rec., Vol. II, May, 1891, p. 606).
No. 329. This is the same article as No. 176.
No. 353. *Add* (see also Ex. Sta. Rec., Vol. II, July, 1891, pp. 749–750).
No. 460. The date *should be* Nov. 7.
No. 476. P. 524 *should be* p. 525.
No. 477. *Add* (see also Ex. Sta. Rec., Vol. III, Nov., 1891, p. 243).
No. 481. *Add* (see also Ex. Sta. Rec., Vol. III, Sept., 1891, p. 101).

No. 483. *Add* (see also Ex. Sta. Rec., Vol. III, Nov., 1891, pp. 225–227).
No. 484. *Add* (see also Ex. Sta. Rec., Vol. III, Dec., 1891, pp. 285–286).
No. 485. *Add* (see also Ex. Sta. Rec., Vol. III, Dec., 1891, p. 287).
No. 486. *Add* (see also Ex. Sta. Rec., Vol. III, Dec., 1891, p. 286).
No. 487. *Add* (see also Ex. Sta. Rec., Vol. III, Dec., 1891, p. 286).
No. 490. *Instead of* [? MASTERS, M. T.] *read* SMYTHE, ——).
No. 509. *Add* (see also Ex. Sta. Rec., Vol. III, Nov., 1891, p. 217.)
No. 514. Oct. 23 *should be* Oct. 31.
No. 515. *Add* (see Agric. Science, Vol. V, Dec., 1891, pp. 282–283, for abstract).
No. 590. *Instead of* [? MASTERS, M. T.] *read* [WAITE, C. J.].
No. 609. *Add* (see also Am. Gardening, Vol. XIV, April, 1892, p. 248, 1 col.; Phar. Jour. and Trans., Vol. LI, London, Jan. 9, 1892, p. 558; Jour. Soc. Arts., Lond., Jan. 1, 1892).
No. 619. Fig. 4 *should be* Fig. 5.
Nos. 632, 633. *Add* (see also Ex. Sta. Rec., Vol. III, Nov., 1891, p. 217).

INDEX TO LITERATURE.

In the following index all articles from foreign sources are indicated by the numbers prefixed being in bold-faced type. All those having numbers with the ordinary type relate to American literature.

A.—WORKS OF A GENERAL NATURE.

654. [ANON.] **Bovine actinomycosis or "lump jaw."** <Am. Agric., vol. L, New York, Jan., 1891, p. 52, fig. 5.

Gives brief historical notes on the disease and describes its character. Due to a fungus. Notes mode of infection, treatment etc. (J. F. J.)

655. [ANON.] **The late F. W. Anderson.** <Am. Agric., vol. LI, New York, Feb., 1892, p. 152, 1 col., port.

Sketch of the life of F. W. Anderson, formerly connected with the Department of Agriculture and later associate editor of the American Agriculturist. (J. F. J.)

656. BIZZOZERO, CARUEL, GIBELLI, PASSERINI, FRINCHESE E TODARO. **Relazione sul concorso al premio Reale per la Morfologia normale e patologica, per l'anno, 1888.** <Atti reale Accad. Lincei, Anno 288, ser. 4, vol. VII, Rome, 7 giugno 1891, pp. 532–543.

Gives discussion of volumes 4–7 of Saccardo's Sylloge Fungorum Omnium, with regard to its claim for the royal prize. Decided to give half the prize to Saccardo and the other half to G. B. Grassi, a zoölogist. (W. T. S.)

657. [EDITORIAL]. **Fungus-eating.** <Nature, vol. XLV, London, Nov. 26, 1891, pp. 75–76.

A notice of M. C. Cooke's "British Edible Fungi," giving a statement of its general scope. Notes that 200 species of British fungi are edible and about 50 of these are considered as dainties. A paragraph is quoted to the effect that no general rules are to be laid down to distinguish edible from poisonous species. (J. F. J.)

658. FAIRCHILD, D. G. **Index to North American mycological literature.** <Jour. of Mycol., vol. VI, Washington, May 14, 1890, pp. 42–44; Sept. 10, 1890, pp. 80–87; Jan. 6, 1891, pp. 128–135; April 30, 1891, pp. 184–191; vol. VII, Sept. 10, 1891, pp. 52–63.

A list, by authors, of papers relating to mycological literature, with brief notes on contents, beginning with January 1, 1890. Now merged in the present index. (J. F. J.)

659. GALLOWAY, B. T. **The work of the United States Department of Agriculture, especially in its relation to plant diseases and injuries to crops through unfavorable weather conditions.** <Hartford Times, Conn., Jan. 27, 1892.

Abstract of a paper read before the Pomological Society of Connecticut, giving an outline of the work of the Department. Various plant diseases discussed and general reference made to value of predictions of frosts by Weather Bureau. (J. F. J.)

660. HALSTED, B. D. **Botany at the Washington meetings.** <Am. Nat., vol. XXV, Phila., Oct., 1891, pp. 914–916.

Mentions the papers, with brief note of contents, read before various societies in Washington, D. C., from August 12 to 29. Many of the papers treated of fungi, of diseases of plants, or of preventives for disease. (J. F. J.)

661. POPE, FRANK M. **Micro-organisms in their relations to the higher animals.** <Trans. Leicester Lit. and Phil. Soc., new ser., vol. II, Leicester Jan., 1891, pp. 256–262.

Gives brief account of history of micro-organisms. Mentions divisions of fungi as (1) Mold fungi; (2) Mycetoza; (3) Yeast fungi, and (4) Fission fungi. Gives brief account of each class giving De Bary's classification of parasitic fungi as obligatory parasites, facultative parasites, and obligatory saprophytes. Notes the presence of mold fungi as more common in plants than animals, but mentions in the latter *Empusa*, *Laboulbenia*, and *Saprolegnia*. Describes effects of bacteria on animal organisms. (J. F. J.)

662. SORAUER, PAUL. **Das phytopathologische Laboratorium zu Paris.** <Zeitsch. für Pflanzenkrankheiten, vol. I, Stuttgart, 1891, p. 51.

Notices the establishment of a laboratory for the study of plant diseases at Paris by order of the Minister of Agriculture on August 24, 1888. Prillieux is director, Delacroix assistant in laboratory work. The laboratory is at 16 Rue Gay-Lussac, in Paris. (W. T. S.)

663. SORAUER, PAUL. **Der Antrag Schulz-Lupitz im preuss. Abgeordnetenhause betreffend die Errichtung einer Versuchsanstalt für Pflanzenschutz.** <Zeitsch. für Pflanzenkrankheiten, vol. I, Stuttgart, 1891, pp. 54–62.

Gives synopsis of a stenographic report of a speech of Schulz-Lupitz in the Prussian Chamber of Deputies, favoring the establishment of a central station for the study of plant diseases. Sorauer opposes this plan, and thinks it better to establish a number of scattered independent stations, giving as reasons that the study can be best carried out in the place where the disease occurs and by investigators familiar with local conditions; that it is difficult to obtain necessary appliances in case an investigator is sent from a central station to the center of disease; that it promotes scientific progress to have investigators free and not under a single head as at a central station, and that local diseases can be recognized and stopped before they attain sufficient importance to demand attention from a central station. (W. T. S.)

664. WARD, MARSHALL. **Two lectures on "Parasitic plants, native and exotic."** <Quar. Rec. Roy. Bot. Soc. London, vol. IV, Lond., April, May, June, 1891, pp. 150–153.

In the second lecture notes are given on parasitic fungi. One attacking *Vaccinium* and one the lily are especially noted. (J. F. J.)

(See also, Nos. 869, 880.)

B.—DISEASES OF NONPARASITIC OR UNCERTAIN ORIGIN.

665. [ANON.] **Cure for the yellows.** <Popular Gardening, vol. VI, Buffalo, Sept., 1891, p. 251.

Notes discussion in regard to disease in a meeting of the Conn. State Board of Agriculture, between Hale and Meech. Former claims pruning and muriate of potash can cure it; Meech claims not. (D. G. F.)

666. [ANON.] **Dreading peach yellows.** <Am. Gardening, vol. XIII, New York, Feb., 1892, p. 128, ½ col.

Quotes from circular of horticultural commissioners of Yuba County, Cal., advising against importation of trees from outside the State. (J. F. J.)

667. [ANON.] **Mysterious vine disease.** <Rural Californian, vol. XV, Los Angeles, Mar., 1892, p. 129, ½ col.

Refers to work of N. B. Pierce on the disease, noting the necessity of using cuttings from healthy vines, and from regions outside locality where the disease exists. (J. F. J.) (See also Cal. Fruit Grower, etc., San Francisco, vol. X, Mar. 5, 1892, p. 154.)

668. [ANON.] **[Take all.]** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Sept., 1891, pp. 556–557.

Mentions a disease of wheat which is often spoken of at farmers' meetings and in the press. A number of specimens were examined, but no conclusion was reached. (M. V.)

669. [ANON.] **The issue on peach yellows.** <Pacific Rural Press, vol. XLIII, San Francisco, Jan. 16, 1890, p. 52.

Editorial on the exclusion of eastern-grown peach trees; shows that exclusion of all eastern trees is absolutely necessary to keep out yellows. Notes are given from Bulletin No. 1, of the Division of Vegetable Pathology, in regard to the communicability of yellows. (B. T. G.)

670. [ANON.] **The peach yellows.** <Cult. and Country Gent., vol. LVI, Albany, Nov. 19, 1891, p. 436, ½ col.

Refers to yellows being transferred from diseased to healthy trees by pruning knife. Disease is sometimes mild, frequently virulent. Cases mentioned where it appeared in trees widely separated. Only remedy so far known is cutting out and burning. (J. F. J.)

671. DODGE, G. M. **Root knot on apple trees.** <Insect Life, vol. II, Washington, April, 1890, p. 315.

Mentions occurrence of knots on roots of apple trees supposed to have come from Kansas. May and may not have been caused by a nematode. (J. F. J.)

672. [EDITORIAL.] **The peach yellows.** <Rural Californian, vol. XV, Los Angeles, Mar., 1892, p. 142, 1 col.

Quotes opinion of Meehan that yellows is caused by *Agaricus melleus*. Argues against the idea and states that the climate of parts of California is certainly favorable for the growth of Agaricus and fruit-growers should be careful about the importation of trees. (J. F. J.)

673. [EDITORIAL.] **The two puzzles. Pear blight.** <Cult. and Country Gent., 61st year, Albany, Dec. 3, 1891, p. 976, ¼ col.

Refers to peach yellows and pear blight and concludes only method of eradication is to cut off and burn diseased parts. Mentions cutting out of diseased wood of pears and advantage resulting from better cultivation of remainder of orchard in producing better fruit. (J. F. J.)

674. [GOETHE, R.] **Einige Ursachen dürftigen Wachsthums der Obstbäume.** <Ber. K. Lehranst. für Obst- und Weinbau zu Geisenheim am Rhein, für d. Etatsjahr 1889-90, Wiesbaden, 1891, pp. 38-40, fig. 1.

As a cause of stunted growth of young nursery trees gives the differences existing between stock and scion. Recommends selection of seed for stocks from vigorous parents and the rejection of all stunted stocks. A common cause of stunted growth is too deep planting. Such deeply set trees are not only stunted, but were liable to diseases and to attacks of insects. Mentions that deep-set trees are more likely to have "Krebs" or in case of stone fruits "gummosis." Such plants also suffer first from frost. Even if planted only 5 cm. too deep the tree suffers. One may suppose the injurious effects of deep planting are due to the injurious effects of the soil moisture on the bark of the buried portion, or that they are due to the hindering of respiration of this portion of the bark, causing stagnation of the sap. One thing is certain, the flow of sap is hindered through the buried stem and causes the production of watersprouts and roots here. Lack of moisture may also be the cause of the trouble. (W. T. S.)

675. "INDIGATOR." **Die-back.** <Fla. Disp., Farmer and Fruit Grower, new ser., vol. III, Jacksonville, Jan. 29, 1891, p. 85.

Gives analyses of soil upon which die-back of orange does and does not exist, showing that soil where it exists has more organic matter and more phosphoric acid than the one on which it is not known. (D. G. F.)

676. JÖNSSON, BENGT. **Om brannfläckar på växtblad.** <Bot. Notiser, Lund, 1891, pp. 1-16, 49-62, pl. 2.

Burnt spots on leaves of plants, which are kept in green or hot houses, have been recorded in the oldest phytopathological literature. Several theories have been given to explain their origin, and the author shows by experiments that the oldest theory, that the burnt spots are caused by the action of the sun's rays through air-bubbles in the glass, is entirely correct. Among the different theories, enumerated and discussed by the author, the following might be mentioned; De Candolle (Physiologie végétale, III, p. 1113) thought that the water might soften the tissue of the leaves and then by being heated in the sun prevent the evaporation and produce burnt spots. Sorauer (Pflanzenkrankheiten, 2nd ed., I, p. 456) says that when drops of water are left upon leaves of plants in hothouses without draught and exposed to the sun, they cause burnt spots. Other authors, Neumann (Adansonia, vol. II, 1862) and Frank in part (Die Krankheit. d. Pflanzen, 1880, p. 174) believed that the drops of water merely by their own heat could produce the burning, but Frank was not unwilling to suppose that the drops might also have the same effect as lenses. Hoffmann (Samenbruch bei der Weinbeere, Bot. Ztg., 1872, p. 113) had observed that grapes upon which drops of water had been left became burnt, and he thought that the drops had really acted as lenses, concentrated the sunlight and produced the burning, and this theory has also been given by Von Thümen (Ueber den Sonnebrand der Rebenblätter, Die Weinlaube, 1886. pp. 409-410). The author has now examined these different theories and he has proved that drops, fallen upon leaves, are unable to burn, since they represent but half a lens, and they are not able to burn by their own heat, since this is far from being strong enough to disturb the tissues. The only acceptable explanation is that poor glass with air bubbles produces the burning, although he is not quite unwilling to see some cause in drops of water which are hanging down from the inside of the glass. (Theo. Holm.) (See Bot. Gaz., vol. XVII, Mar. 17, 1892, pp. 89-91.)

677. MAY, WALTER. **Die Rohrzucker-Culturen auf Java und ihre Gefährdung durch die Sereh-Krankheit.** <Bot. Zeit. 49 Jahrg. Leipzig, Jan. 2, 1891, pp. 10-15.

After giving a general account of the soil and climatic conditions in Java in reference to the culture of sugar cane, the author describes the Sereh-disease. It appeared in Java in 1879-1880 but did not cause much damage until five years later, when it spread rapidly over almost the entire island, causing immense loss. Since then the disease has prevailed to greater or lesser extent every year. The outer symptoms of the disease are given thus: The stems remain short, the leaves are crowded, many branches and aërial roots are produced; the diseased plants do not develop a tall upright stem, but form a small fan-shaped tuft of leaves. In the worst cases no cane is produced, only leaves; certain tissues of the diseased plants become reddened, and cuttings taken from such plants show an increased redness and finally decay. The checked growth of the diseased plants brings about a diminished sugar content and the sugar present is difficult to secure. As to the cause of the disease no generally accepted explanation has been put forth. Nematodes, bacteria and even methods of culture newly introduced have been supposed by different writers to be the cause. The best means of combating the malady at present known is to obtain sets from Sereh-free regions such as Borneo. (W. T. S.)

678. McCALLAN, C. W. [and HOWARD, L. O.]. **The Bermuda peach maggot and orange rust.** <Insect Life, vol. III, Washington, Nov., 1890, pp. 120-121.

Describes disease of oranges. Trees die from limb to limb in one year. New shoots also die rapidly and in three or four years the tree is entirely dead. This is said to be die-back. Disease yields to treatment with carbolic or creosote washes "provided the existing cause is removed, and this latter is variously ascribed to over-fertilization, deep planting and imperfect drainage." (J. F. J.)

679. [MEEHAN, T.] **Peach yellows.** <Meehan's Monthly, vol. I, Germantown, Pa., Oct. 1891, p. 55, ½ col.

Considers disease due to *Agaricus melleus.* (J. F. J.)

680. [MEEHAN, T.] **Peach yellows.** <Meehan's Monthly, vol. II, Germantown, Pa., Feb. 1892, p. 27, ½ col.

Refers to fears of spread of peach yellows in California. Considers disease due to *Agaricus melleus.* "We would just as soon expect to hear of the peach yellows in California as we would to hear of an acre of pineapples being produced in Maine." (J. F. J.)

681. RÁTHAY, EMERICH. **Ueber eine merkwürdige durch den Blitz an Vitis vinifera hervorgerufene Erscheinung.** <Denkschr. d. math. naturw. Classe d. K. Akad. d. Wissensch. Bd. LVIII, Wien, 1891, pp. 26, pl. I–II.

An interesting and exhaustive paper on the remarkable effects produced by lightning on *Vitis vinifera.* The author discusses the autumnal coloration of grape foliage, the coloration as a result of mechanical injuries to the leaf veins, the petioles and shoots, coloration due to lightning and various questions concerning the effects of lightning on vines grown under glass. The paper concludes with the following summary:

(1) According to observations hitherto made, lightning in graperies, as in herds of sheep, does not single out individuals but strikes large numbers; (2) the tips of shoots struck by lightning die, while the parts lower down survive, at least for some time; (3) the assertion of Colladon's, which is doubted by Caspary, that the foliage of the vine is reddened by the effects of lightning, is correct in regard to all vines whose foliage shows red coloration in the fall; (4) the latter is peculiar to *Vitis sylvestris*, is furthermore to all purple and certain red varieties of *Vitis vinifera* and finally to certain, but by no means all purple, varieties of American vines; (5) vines that redden in the autumn also do so as a result of mechanical injuries to the leaf-nerves, petioles, and stems. Girdling, bending, and partial severing of the latter, produces a red discoloration of all leaves above the injured parts; (6) the reddening of vine leaves after receiving mechanical injuries is not conditioned by a diminished transportation of water; (7) vine leaves, that assume a red color as a result of mechanical injuries, transpire much less than green leaves; (8) the red coloration of vine leaves caused by lightning, resembles in every respect that occurring as the result of mechanical injuries; (9) the change in color is only an indirect result of lightning caused by the latter killing the tissue found on the outside of the cambium in the middle pieces of numerous successive internodes, which corresponds to a repeated girdling; (10) the cambium of the shoots attacked by lightning continues to live and produces, in an outward direction, a callus within the deadened tissues, surrounded with cork, while in an inner direction it produces a ring of wood, which is separated from the older wood by a thin brown layer; (11) according to the observations of many, the berries struck by lightning dry up completely. (B. T. G.)

682. SAHUT, FÉLIX. **Les végétaux considérés comme des thermomètres enregistreurs.** <Ann. Soc. d'hort. et d'hist. nat. de l'Hérault, 2 sér. tome XXIII, Montpellier, May, June, 1891, pp. 158–178.

Discusses the effect of cold on introduced plants from observations made in southern France during a period of more than thirty years. The conclusions are as follows: (1) All other conditions being the same, individuals whose wood is well ripened will resist cold more than those whose wood is not well ripened. Individuals of some tender species will be affected more or less by the same degree of cold according as they are in a more or less active state of vegetation. (2) Given a specific fall of temperature, plants, for the most part at least, will be much more seriously affected if the air be moist than if it be dry. (3) With equal temperatures, other conditions remaining the same, the effects of cold will be more destructive if the trees and plants be violently shaken by the wind at the time of a great fall of temperature. Plants which resist 12° in still air may freeze at 8° in windy weather. (4) The effects of a given lowering of temperature will be destructive in proportion to the persistence of the cold. (5) The resistance to cold of a woody plant increases in proportion to its arborescence. (6) In like conditions, also, a sickly plant will be more sensitive to cold than a healthy one. Chlorotic vines, for instance, are much more subject to cold than healthy ones placed side by side. (7) Observations must not be confined to a single individual. In different individuals of every species the resistance to cold varies appreciably. The author believes it is possible by an intelligent selection carried on for a number of generations to create in many species of plants races less tender than those we are familiar with. (E. F. S.)

683. SMITH, ERWIN F. **The peach rosette.** <Jour. Mycol., vol. VI, Washington, April 30, 1891, pp. 143–148, pl. VIII–XIII.

Describes a disease similar in its appearance and effects to peach yellows, mentioning points of resemblance and difference. Occurs in Georgia and Kansas. Does not consider it due to attacks of insects, as has been supposed. The disease is contagious, and affected trees should be dug out and burned. (J. F. J.)

684. SMITH, ERWIN F. **What to do for peach yellows.** <Jour. Mycol., vol. VI, Washington, Mar., 1890, pp. 15–16.

Mentions experiments made with fertilizers, which do not warrant recommending any special treatment. Only plan suggested is to dig out and burn affected trees. (J. F. J.)

685. "VIOLET." **The violet disease.** <Am. Florist, vol. VI, Chicago and N. Y., Feb. 18, 1892, p. 590, 1 col., fig. 1.

Gives experience in raising violets and says, "keep the cold water off your violet foliage and you will have no disease." (J. F. J.)

686. VÖCHTING, HERMANN. **Über die Abhängigkeit des Laubblattes von seiner Assimilations-Thätigkeit.** <Bot. Zeit., 49 Jahrg., Leipzig, Feb. 20, 1891, pp. 113–125, Feb. 27, 129–143, pl. 1, (III.)

Experimented with *Mimosa pudica*, *Solanum tuberosum*, *Tropæolum lobbianum*, *Dolichospermum halicacabum*, and an ornamental cucurbit. In all cases a part of the stem was placed in a space containing air free from CO_2 and exposed as usual to the sun. In every case old leaves already formed when introduced into CO_2-free air turned yellow, and in many cases fell off. The young leaves formed in CO_2-free air showed abnormal shape, size, and color, but differed from etiolated leaves. Such leaves did not recover when the plant was placed in normal atmosphere again. Shows plainly that leaves are dependent on their own assimilation for growth beyond a certain stage of development, and also that they must assimilate to support themselves when fully grown. (W. T. S.)

687. WADSWORTH, C. D. **Is the violet disease a myth?** <Amer. Florist, vol. VII, Chicago and N. Y., Dec. 31, 1891, p. 443, ½ col.

Gives experience with violets and believes the so-called disease is due entirely to "wrong treatment, or some parasite, insect, or something of that nature attacking the plants." (J. F. J.)

688. WADSWORTH, C. D. **The violet disease.** <Am. Florist, vol. VII, Chicago and N. Y., Feb. 25, 1892, p. 624, ½ col.

States failure to grow violets and concludes it to be due to the soil used. (J. F. J.)

(See also Nos. 739, 752, 758, 759, 766, 774, 775, 777, and 781.)

C.—DISEASES DUE TO FUNGI, BACTERIA, AND MYXOMYCETES.

I.—RELATIONS OF HOST AND PARASITE.

689. ARCANGELI, G. **Sopra i tubercoli radicale delle leguminose.** <Atti reale Accad. Lincei Anno 288, ser. 4, vol. VII, Rome, Mar. 15, 1891, pp. 223–227.

Review of recent work on root tubercles of Leguminosæ. Says Woronin did not discover bacteria in the tubercles, but instead Gasparrini, who published in 1851 in Atti acad. sc. d. Napoli, t. VI, as was recently noted by Pirotta. (W. T. S.)

690. DARMSTÆDTER, LUDWIG. **Der Schutz der Pflanzen und Thiere durch Wachse und Fette.** <Prometheus, Jahr. II., vol. XXXVI, Berlin, 1891, pp. 572-574.

Looks upon wax forming the bloom in many plants and a thick coating in some, as a protection against parasites. The wax is not glycerine-ether but combinations of fatty acids with higher fatty alcohols. (W. T. S.)

691. KIONKA, H. **Die Wurzelknöllchen der Leguminosen zusammenfassender Bericht über die Gesammte diesbezügliche Litteratur mit besonderer Berücksichtigung der neueren.** <Biol. Centralbl. Bd. XI, Leipzig, June 1891, pp. 282-291.

A good resumé of recent work on the subject of root tubercles of Leguminosæ. (W. T. S.)

692. MAGNIN, ANT. **Sur quelques effects du parasitisme chez les vegetaux.** <Comp. rend. Acad. d. Sci., vol. CXIII, Paris, Nov. 30, 1891, pp. 784–786.

In reply to criticisms by M. Vuillemin, M. Magnin explains that in speaking of the smutted flowers of *Lychnis dioica*, he used the term hermaphrodite in a morphological rather than physiological sense. The anthers are not filled with pollen grains but always with spores of *Ustilago*. Some additional facts confirm M. Vuillemin's observations: (1) The possibility of local infection, suspected by M. Rose and verified by M. Vuillemin, must also be admitted for *Euphorbia cyparissias* and *E. verrucosa*, emasculated by *Uromyces pisi* and *U. scutellatus*; (2) as in case of *L. dioica*, the parasite which causes stamens to appear in the neuter flowers in *Muscari comosum* only increases the size of organs which exist already in a more or less atrophied form in the neutral flowers of healthy plants; (3) ovaries have never been observed in the smutted staminate flowers of *Lychnis vespertina* or *Muscari comosum*, and this is another proof that whenever such changes take place the rudiments of the organs must have been present. The smut exerts a remarkable indirect effect on the peduncles of the staminate flowers in *Lychnis*. In the healthy staminate plant the flower falls early and the peduncle quickly dries. On the contrary in the pistillate plant the peduncle persists until after the dissemination of the seeds. Now, in parasitized staminate flowers the peduncle also persists quite a long time after anthesis, simulating the pistillate flowers. (E. F. S.)

693. [MEEHAN, T.] **Bacteria and plant diseases.** <Meehan's Monthly, vol. II, Germantown, Pa., Jan., 1892, p. 8, ½ col.

Notes general belief that bacteria are sole cause of disease. This has not been demonstrated. Believes they may hasten disease in plants while not causing it. (J. F. J.)

694. TAYLOR, JOHN. **Grafting reputed blight-proof apples on blighty stocks.** <Agric. Gaz. N. S. Wales, vol. II, April, 1891, p. 224.

Mentions successful experiment made in grafting reputed blight-proof apples on "blighty" stocks. (M. V.)

(See also Nos. 711, 807, 855, 871, 873, 894, and 981.)

695. [ANON.] **Botany.** <Univer. Rec., Univ. of Michigan, vol. 1, Ann Arbor, Apr. 1891, pp. 16–17.

Notices laboratory studies of A. C. Eycleshymer, upon club root (*Plasmodiophora bras[sicæ]*) of cruciferous plants, and of W. H. Rush on *Peronospora gangliformis*. (See Nos. [illegible] and 377.) (D. G. F.)

696. [ANON.] **Peronospora hyoscyami.** <Wiener illust. Gart.-Zeit., 16 Jahrg., Wien, März, 1891, p. 130.

Short notice stating that *Peronospora hyoscyami* is found in Europe almost exclusively on *Hyoscyamus*, but news is received from Australia that it is doing great damage to tobacco. Bordeaux mixture is recommended as a preventive measure. (W. T. S.)

697. [ANON.] **Rust in wheat conference.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, July, 1891, pp. 403–406.

Gives many recommendations for the immediate attention of the farmer, as for example: general experience shows that early sown wheat frequently escapes rust when late [illegible]. (M. V.) (See also Agric. Jour. Cape Colony, vol. v, June 2, 1892, pp. 44–45: this JOURNAL, pp. 287–289.)

698. [ANON.] **Smut in wheat.** <Bull. No. 32, Dept. Agric. & Immigration, Winnipeg, Feb. 25, 1892, pp. 8.

Notes two kinds of smut in wheat, loose or black smut and bunt or stinking smut. Describes the two diseases and their reproduction. Under head of "treatment" suggests use of sulphate of copper (1 pound to 8 quarts of water for 8 bushels of seed): spread on [floor] and sprinkle with solution and then sift on dry lime to hasten drying. Seed may also be treated in a vat. (J. F. J.)

699. ATKINSON, G. F. **A new root-rot disease of cotton.** <Insect Life, vol. III, Washington, Mar., 1891, pp. 262–264.

Describes a disease due to a species of Nematode worm, *Heterodera radicicola*. The external characters are similar to those caused by the fungus *Ozonium*. (J. F. J.)

700. ATKINSON, GEO. F. **Anthracnose of cotton.** <Jour. Mycol., vol. VI, Washington, April 30, 1891, pp. 173–178, pl. XVII, XVIII.

Gives detailed description of fungus causing the disease (*Colletotrichum gossypii* Southw.) (See No. 732). (J. F. J.)

701. BARCLAY, A. **Rust and mildew in India.** <Jour. Bot., vol. XXX, London, Jan. 1892, pp. 1–8, pl. 1, 2 diagrams.

Refers to extent of injury from rusts, etc., in all parts of the world. Quotes from Bolley as to occurrence in the United States, and notes its being found in India, Australia, Japan, etc. Estimates loss to wheat growers in India at nearly 3,000,000 rupees annually. (J. F. J.)

702. BOLLEY, H. L. **Potato scab, a bacterial disease.** <Proc. Am. Asso. Adv. Sci., vol. XXXIX, Salem, Mass., July, 1891, pp. 334–335.

Abstract giving a statement of contents of paper. Concludes the bacterial origin of disease to be proved by finding (1) a specific bacterium in the true scab; (2) raising diseased tubers from diseased seed and tubers free from disease from treated seed; (3) raising healthy tubers by isolation in same hill where all others became diseased; and (4) producing disease in healthy tubers by artificial infection. (See also, Nos. 119, 120, 121.) (J. F. J.)

703. C[HURCHILL, G. W.]. **Anthracnose of the bean.** <Cult. and Count. Gent., vol. LVII, Albany, N. Y., Feb. 4, 1892, p. 88, ¼ col.

Refers to appearance of beans affected by the disease, and recommends that they be soaked before planting in solution of 3 oz. carbonate of copper dissolved in one quart of ammonia and diluted with 4½ gallons of water. The beans should be soaked in the solution for an hour. (J. F. J.)

704. COBB, N. A. **Notes on diseases of plants.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, May, 1891, pp. 285–287.

Describes diseased horse-radish plants attacked by *Cystopus candidus*, and recommends as remedies rotation of crops and clean cultivation. Pulverized lime, flowers of sulphur, or eau celeste might also be tried. Recommends clean cultivation, destruction of diseased plants, and rotation of crops for diseases of maize caused by *Ustilago maydis* and *Puccinia maydis*. Under head of diseased lucerne, caused by *Sphærella destructiva*, refers to remedies previously given. (See No. 705.) Says in regard to "water core" of apple that it is not a fungus disease, but is due to lack of air and too much water. (M. V.)

705. COBB, N. A. **Pathological notes.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Feb., 1891, pp. 107–108, fig. 4.

Under subhead "A Disease of Lucerne" (*Sphærella destructiva* B. and B.), speaks of part of host attacked, the appearance and amount of the disease. Describes briefly microscopical appearance and germination of spores. Recommends good surface drainage and a rapid succession of close mowings. Reference is also made to sphæriaceous fungi and wheat rust spores, which have been scattered by currents of air and are found on red incrusted fence rails, together with a species of lichen, which is the true cause of the red color. (M. V.)

706. COBB, N. A. **Pathological notes.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, April, 1891, p. 215.

Gives a popular description of maize affected with rust, the probable cause being *Puccinia maydis*. States also that apple scab may be almost entirely prevented by spraying trees once every two or three weeks in spring and summer with modified eau celeste. (M. V.)

707. [EDITORIAL.] **The potato disease.** <Mediterranean Nat., vol. I, Malta, Sept., 1891, p. 54, ½ col.

Notes two diseases affecting potatoes, one caused by *Phytophthora infestans*, the other by a bacterium, *Clostridium butyricum*. The last disease may be arrested by placing the potatoes, after they are dug, in "a light, dry, airy place." (J. F. J.)

708. FALCONER, WILLIAM. **Some notes on the celery crop.** <Cult. and Country Gent., vol. LVII, Albany, Jan. 14, 1892, pp. 28–29, ¾ col.

Notes rusting of celery on Long Island; this prevents early blanching. (J. F. J.)

709. [?FAWCETT, W.] **Coffee-leaf disease.** <Bull. Bot. Dept. Jamaica, No. 22, Kingston, July, 1891, p. 3, ½ p.

Notes the danger of introduction of *Hemileia vastatrix* into Jamaica, and gives proclamation relative to destruction of coverings of tea chests to prevent introduction of the fungus spores from Java or Ceylon. (J. F. J.)

710. [?FAWCETT, W.] **Dr. Burck's method of treatment of the coffee-leaf disease in Java, [with notes].** <Bull. Bot. Dept. Jamaica, No. 22, Kingston, July, 1891, pp. 3–10.

An abstract, with notes, from a paper by Burck published in the "Javaasche Courant." States the disease is due to a fungus, *Hemileia vastatrix*, which attacks the lower surfaces of the leaves and gains entrance to the interior through the stomata. The spores develop only in water and in darkness, light and moisture together being destructive to them. The infection of the leaves is described and suggestions are made for cure or prevention. The third pair of leaves on each branch, is the one first attacked. If taken in time and the diseased spot punctured with a needle having on its tip a small amount of sulphuric acid, or if it be cut out with a pair of scissors made especially for the purpose, the disease can be checked. It can also be prevented by spraying with copper sulphate, sulphate of quinine and tobacco water. The expense of treating plants is very slight, not exceeding 1½ guilder cents each from the time of sowing until coming into bearing. Planting hedges so as to intercept the wind is also recommended. (J. F. J.)

711. [?FISCHER, A.] **Agricultural prospects generally.** <Agric. Journ. Dept. of Agric. of Cape Colony, vol. IV, Cape Town, Jan. 14, 1892, pp. 156–157.

Report from Graaff-Reinet states that rust is injuring wheat, some farmers reporting one-third of a crop lost. At Humansdorf nearly all soft wheat perished with rust, but hard wheat, such as Blaauw-Horn withstood the rust. Oat hay was injured by rust. At Peddie rust is reported bad on hard wheat; beans "rusted" in some parts of the district. The earlier varieties of grapes "are affected with rust." At Steynsburg and Uniondale rust is reported on wheat to some extent. (W. T. S.)

712. [?FISCHER, A.] **The wheat crop.** <Agric. Journ. Dept. of Agric. of Cape Colony, vol. IV, Cape Town, Jan. 14, 1892, pp. 155–156.

Additional reports from seed inspectors are given. Rust is reported as destructive at Dooren Kloof and Tarkastad in the eastern districts. At Dooren Kloof "the rust was worse this year than it has been for years; several people just burnt off their wheat to clean the lands; others cut it off for bedding for their horses. Even the best wheat reaped was rusty." (W. T. S.)

713. GALLOWAY, B. T., and SOUTHWORTH, E. A. **Preliminary notes on a new and destructive oat disease.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, pp. 72–73.

Give notes on a disease of oats caused by bacteria. Inoculations with the bacteria produced characteristic features of the disease in five days. Cultures yielded the typical organism in a nearly pure condition. (See abstract in Proc. Am. Asso. Adv. Sci., vol. 39, July, 1891, Salem, Mass., p. 333, six lines.) (J. F. J.)

714. HALSTED, B. D. **Black rust of cotton.** <Am. Agric., vol. L, New York, Oct., 1891, p. 539, ¾ col.

A notice of various diseases to which cotton is subject and a special reference to a new disease produced by *Macrosporium rugricantium* Atkinson. Advocates keeping plants in good condition so as to ward off attacks of disease. (J. F. J.) (See No. 246*a*.)

715. HALSTED, B. D. **Experiments with sweet potatoes.** <Cult. and Country Gent., vol. LVII, Albany, Jan. 14, 1892, p. 28, 1½ col., 1 diagram.

Gives results of experiments with various manures and fertilizers on black rot and soil rot. (J. F. J.)

716. HALSTED, B. D. **Fungous diseases of various crops.** <Eleventh Ann. Rept. N. J. Agric. Ex. Sta., New Brunswick, 1891, pp. 345–366, fig. 3.

Gives notes upon various diseases of garden and ornamental crops. Notes presence of *Phytophthora infestans* as destructive in various parts of the State; also presence of the parasite in potatoes sent from Ireland. Notes occurrence of the bacterial blight of Burrill

and refers to the scab described by Thaxter and Bolley. Records *Plasmodiophora brassicæ* Wor., upon cabbage and radish, and for the first time in America *Peronospora parasitica* DBy., on leaves of cabbage and *Hesperis matronalis*. Notes also *Macrosporium brassicæ* Berk., on cabbage. *Cystopus candidus* (Pers.) Lév., is recorded as doing damage on radish, and a *sclerotial* disease of turnips and carrots is noticed. A bacterial disease of salsify is spoken of as quite widespread in the State and likely to prove very contagious. *Botrytis parasitica* and *Urocystis cepulæ* are reported as doing damage to onions and onion sets. Notes presence of *Cercospora flagilleformis* E. & Hals., n. sp. on spinach, and reviews work done in Bull. 70 of N. J. Ex. Sta. (See No. 135). Gives figures of *Phyllosticta hortorum* Speg., on the eggplant, where it causes serious losses, together with *Glœosporium melongenæ* E. & E. Figures, with description *Glœosporium piperatum* E. & E., and *Colletotrichum nigrum* E. & Hals., and notes a species of *Phyllosticta*, all three on the foliage of the pepper. Notes presence at Piscataway of *Septoria armoraciæ* Sacc., and *Ramularia armoraciæ* Fl., on leaves of horse radish. Discusses diseases of the cultivated hollyhock, *Puccinia malvacearum* Mont., *Cercospora althæina* Sacc., and *Colletotrichum malvarum* (B. & Casp.) Southworth. The violet (*V. odorata*) diseases are reviewed shortly and mention made of *Cercospora violæ* Sacc., *Phyllosticta violæ* DBy., *Glœosporium violæ* B. & Br., and *Zygodesmus albidus* Ell. & Hals. The fungi especially troublesome to carnations mentioned are *Septoria dianthi* Desm., and *Vermicularia subefigurata* Schw. *Cercospora resedæ* Fckl., on cultivated mignonette is mentioned as controlled by Bordeaux mixture. The black knot of plum and cherry trees is treated of and reference made to Bull. No. 78 N. J. Agric. Ex. Sta. Quotes report of J. M. White who was successful in the treatment of his Clairgeau and Deil pears for leaf-blight and cracking by use of ammoniacal solution, 6 oz. copper carbonate in 100 gallons of water. Mr. White estimates the cost of treating an orchard of 100 apple trees thirty to forty years old five times with carbonate of copper at about $20. (See Exper. Sta. Rec., vol. III, Dec., 1891, pp. 306–308.) (D. G. F.)

717. HALSTED, B. D. **Soil-rot of the sweet potato.** <Cult. and Country Gent., vol. LVI, Albany, N. Y., Mar. 5, 1891, p. 148, 1 col., fig. 1.

Gives popular description of disease with possible remedies. (See No. 53.) (D. G. F.)

718. HALSTED, B. D. **The black-rot of the sweet potato.** <Cult. and Country Gent., vol. LVI., Albany, N. Y., Feb. 5, 1891, p. 104, 2 cols., fig. 1.

Gives popular description of disease of sweet potato caused by *Ceratocystis fimbriata* Ell. & Hals. (See No. 53.) Reviewed in Popular Gardening, Buffalo, N. Y., vol. VI, Apr., 1891, p. 128. (See No. 264.) (D. G. F.)

719. HALSTED, B. D. **The scab of potatoes.** <Am. Agric., vol. LI, New York, Mar., 1892, p. 171, 1 col.

Gives a list of various theories advanced to account for scab. Concludes that real cause is a fungus. Gives outline of work of Bolley, Thaxter, Humphrey, and others, and mentions means advocated for its prevention. (J. F. J.)

720. HALSTED, B. D. **The southern tomato blight.** <Miss. Agric. and Mechanical Col. Exper. Sta., Bull. No. 19, Jan., 1892, Agric. Col., pp. 1–9, 11–12.

Describes disease and gives experiments in inoculation of tomatoes from diseased potatoes, and *vice versa*. Seedlings also experimented with, with rather unsatisfactory results. The conclusions are that the blight is due to a *bacterium*, probably the same as that causing the potato disease; that it is also the same as the blight of cucurbits, and can be transferred from one to the other, and that spraying with Bordeaux mixture will probably prove a remedy or preventive. (See Gard and Forest, vol. V., Mar. 2, 1892, p. 108; Exper. Sta. Rec., vol. III, May, 1892, p. 702.) (J. F. J.)

721. HALSTED, B. D., and FAIRCHILD, D. G. **Sweet potato black-rot.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 1–11, pl. I–III.

Describe the external appearance, characteristics, cultures, inoculations, probable life history, and preventive measures. The latter are selections of healthy seed potatoes, healthy sprouts for transplanting from hot bed, rotation of crops, burning of refuse, sparing use of barnyard manure, and dipping roots in ammoniacal solution of copper carbonate before storing in bins for winter. (J. F. J.)

722. HARVEY, F. L. **Causes of potato scab.** <Ann. Rept. Maine Agric. Ex. Sta., part IV, Orono, Dec. 31, 1890 (1891), pp. 115–117.

Reviews work of Thaxter and Bolley on subject. (See No. 311. Also Exper. Sta. Record, vol. III, Jan., 1892, pp. 395–396.) (D. G. F.)

723. KELLERMAN, W. A. **Rusts and smuts of wheat.** <Farm, Field and Stockman, vol. XV, Chicago, Feb. 13, 1892, p. 151, 1½ col.

Gives brief outline of life history of rust and smut, and recommends immersion of seeds in water heated to from 132° to 135° for prevention of smut. (B. T. G.)

724. LAGERHEIM, G. DE. **La enfermedad de los pepinos.** <Revista Ecquatoriana, tom. II, Quito, Dec., 1890, pp. 1–6.

Relates to a disease of Pepinos (*Solanum muricatum*) in Ecuador caused by *Phytophthora infestans*. A general account of the fungus is given, together with notes on distribution, hosts, remedies, etc. The author adopts Mille Libert's name, *Phytophthora devastatrix*, on the ground of priority. (B. T. G.)

725. LAGERHEIM, G. DE. **Remarks on the fungus of a potato scab.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 103–104.

The disease is caused by *Spongospora solani* Brunch., and was noticed in potatoes purchased in Quito, Ecuador. Describes minute characters of the fungus and gives a short synonymy of the species, concluding it should be known as *Spongospora subterranea* (Wallr.). (J. F. J.)

726. [MEEHAN, T.] **The potato disease.** <Meehan's Monthly, vol. II, Germantown, Pa., Jan., 1892, p. 13, ½ col.

Notes that spores of fungus do not penetrate the plant, but, falling to the ground, are carried to tubers by the rain and cause rot. Spores seldom penetrate the ground more than 4 inches, and hilling up the vines as early as possible in the season is recommended as a preventive of rot. (J. F. J.)

727. PAMMEL, L. H. **New fungous diseases of Iowa.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 95–103.

Discusses fungi affecting cereals, fruits, and forest trees. Under the first are considered diseases of wheat, barley, timothy, brome grass, Panicum, and clover. Under fruit diseases are considered plum scab or black spot, anthracnose of currants, clustercup of gooseberries, black knot of plums, and white rust of beets. Under forest trees are discussed blight of *Æsculus*, cedar apple fungus, and walnut-tree diseases. (J. F. J.)

728. PAMMEL, L. H. **Potato scab.** <Orange Judd Farmer, vol. XI, Chicago, Jan. 9, 1892, p. 19, 2 col., fig. 1.

Gives popular résumé of recent investigations of Bolley and Thaxter upon the disease. (See Nos. 311, 120, and 121.) (D. G. F.)

729. PECK, C. H. **The potato rot fungus.** <Cult. and Count. Gent., vol. LVII, Albany, N. Y., Feb. 4, 1892, p. 85, ½ col.

Refers to losses caused by potato rot and to the value of Bordeaux mixture as a preventive. Gives formula. (J. F. J.)

730. PRILLIEUX & DELACROIX. **La nuile, maladie des melons, produite par le Scolecotrichum melophtorum, nov. sp.** <Bull. Soc. Mycol. France, vol. VII, Paris, Dec. 31, fasc. 4, 1891, pp. 218–220, fig. 1.

Gives description of external appearance of the diseased fruit and technical description of the fungus. Notes its successful cultivation in artificial media. (E. A. S.)

731. S——. **Die Kartoffelkrankheit in Irland.** <Naturwissensch. Wochenschr., vol. VI, Berlin, Aug. 30, 1891, p. 358.

Notices a disease affecting potatoes in Ireland caused by *Peziza sclerotiorum*. (J. F. J.)

732. SOUTHWORTH, E. A. **Anthracnose of cotton.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 100–105, pl. 1 (IV), fig. 1.

Disease due to a new species of fungus described under name of *Colletotrichum gossypii*. Mentions external appearance and effect on the boll. Botanical characters and general notes. States there is reason to fear it will be difficult to prevent disease by fungicides. (J. F. J.)

733. [SWINGLE, W. T.] **[Rust of cereals.]** <U. S. Dept. of Agric., Div. of Veg. Path., Cir. No. 12, Washington [Dec., 1891], p. 1.

A circular of inquiry to ascertain the amount of wheat rust in the country, varieties attacked, remedies, etc. (J. F. J.)

734. WEED, C. M. **The smut of oats.** <Am. Agric., vol. LI, New York, Mar., 1892, pp. 183–184, figs. 4.

Notes losses from smut in different years and localities and states it can be prevented, as discovered by Jensen, by soaking in hot water. Gives brief life history of fungus, with account of microscopic characters and remedies. The best method is treating seed with hot water at a temperature of 133° F. for five or ten minutes. (J. F. J.)

735. WEED, C. M. **Wheat "scab."** <Am. Agric., vol. L, New York, Dec., 1891, p. 693, 1 col., figs. 2.

Describes appearance of wheat affected by scab. Due to species of *Fusisporium*. Mentions great loss resulting from the disease. (J. F. J.)

736. WORONIN, M. **Ueber das "Taumelgetreide" in Süd-Ussurien.** <Bot. Zeit., 49 Jahr., Leipzig, Feb. 6, 1891, pp. 81–93.

In 1888 the author's attention was called to a serious disease of grains in South Ussuria, and in 1889 he received specimens from Wladywostok, together with drawings and descriptions of the fungi occuring thereon made by N. Paltschewsky and N. Epoff. Gives a short review of the literature of similar diseases of grains, stating that the appearance of "intoxicating grain" is no new phenomenon, it having been previously reported from Germany and Sweden. The diseased grain, when eaten, produces in men a serious disease; the principal symptoms being pain in the head, vertigo, nausea, loss of sight, etc. In South Ussuria besides rye, wheat, oats, millet, etc., were diseased, and not only men, but also animals

were affected by eating the grain. The following were found on the diseased ... *Fusarium roseum* Lk., *Gibberella saubinetii* Sacc., *Cladosporium herbarum* Lk., ... *thosporium* sp., *Epicoccum neglectum* Desm., *Trichothecium roseum* Lk., *Eurotium* ... *rum* Lk., *Micrococcus* sp. [causing red grains], *Hymenula glumarum* Cke. & Harkn., ... or *Didymella*, *Cladochytrium graminis* Büsg. Besides these, some unidentified ... enumerated, one of which, a black stroma, looked extremely like *Puccinia graminis* ... latter fungus was almost entirely absent. All of the fungi, except *Puccinia graminis* ... *Cladochytrium graminis* (both of which were rare), are saprophytes, and are ... the direct cause of the disease, which is considered to be due to the damp summer ... inducing molding of the grain during curing. As a preventive measure, the ... the neighboring people—Chinese and Coreans—is recommended. This consists ... drying the grain under shelter and thus prevent its molding. Careful selection ... also enjoined. The cause of the disease produced in men and animals, the ... due to one or more of the following: *Fusarium roseum*, *Gibberella saubinetii*, *Ex*... *sporium* sp., *Cladosporium herbarum*. W. T. S.)

(See also Nos. 743, 827, 833, 840, 843, 864, 885, 973, and 984.)

III.—DISEASES OF FRUITS.

737. [ANON.] **Orange-tree diseases.** <Fla. Disp., Farmer and Fruit Grower, n. s., vol. III, Jacksonville, July 16, 1891, p. 563.

Reports account of visit of Erwin F. Smith and W. T. Swingle, agents of the U. S. Dept. of Agric., to Florida to investigate the diseases of oranges. (D. G. F.)

738. ARGYNNIS [SHARPE, ALDA M.]. **Plums affected by fungus.** <Prairie Farmer, vol. LVIII, Chicago, July 4, 1891, p. 422, ½ col., fig. 1.

Figures plum with plum pockets, *Taphrina pruni*, giving short popular account of the disease. (D. G. F.)

739. BAILEY, A. **New disease of the orange.** <Fla. Agric., vol. XVIII, De Land, Nov. 11, 1891, p. 603, ⅓ col.

Describes disease on sweet orange similar to "scab." Appeared first on lemon and ... to oranges. Sulphur solution, 10 or 12 gallons to 40 gallons of water, partially checked the disease. (J. F. J.)

740. BRUNK, T. L. **Plum knots.** <Am. Farmer, 10th ser., vol. X, Baltimore, May 1, 1891, p. 102, ⅓ col.

Notes disease to be caused by *Spharea morbosa* [*sic*], and describes method of its prevention. Recommends painting knots with linseed oil in the spring, and then "no spores ... be found in the warts and they will crumble and fall away." Red oxide of iron mixed with linseed oil gives perhaps better results than oil alone. Recommends also cutting out badly diseased trees. (J. F. J.)

741. BUTZ, GEO. C. **Black knot on plums.** <Ann. Rept. Penn. State College for 1890, Harrisburg, 1891, pp. 166–167, pl. 1.

(See No. 251.) (J. F. J.)

742. COBB, N. A. **Notes on diseases of plants.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Jan., 1891, pp. 60–62.

Gives a short popular description of anthracnose or black spot on grapevines and condition favorable for its development; also three remedies. Gives formulæ for making Bordeaux mixture and eau celeste, speaks of the success of these remedies in Europe and America. Then treats of "pear blight" (*Fusicladium pirinum*). Speaks of the close resemblance of this fungus and that causing apple scab. Recommends ammonia-carbonate of copper to be used for spraying the trees and gives formulæ for making. Under head of strawberry leaf-blight mentions places from which specimens of this disease have been received and gives remedies for prevention. Under "Rust on marsh mallows" quotes from a letter that it is popularly believed this rust is in some way connected with wheat rust. Makes one or two statements to show that this is probably not true. (M. V.)

743. COBB, N. A. **Notes on diseases of plants.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Mar., 1891, pp. 155–157.

Gives popular description of bitter rot of apple (*Glæosporium versicolor*), showing also that the disease can be given to other fruits, such as peach, cherry, mango, etc.; mentions treatment. Notes presence of "pear mite" and *Fusicladium* and their resemblance to each other, giving remedies for both diseases. Linseed plants from India and New Zealand were attacked by *Melampsora lini*, which caused great loss; finally, for peach rust recommends burning leaves, spraying trees in winter with sulphate of iron (1 pound to 8 gallons of water), and application of potash manures. (M. V.)

744. COBB, N. A. **Notes on diseases of plants.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, June, 1891, pp. 347–348.

Describes method of entrance of spores of common mold into core of apples, producing what is known as "moldy core." Recommends modified eau celeste as a probable remedy. Also quotes from Gardeners' Chronicle a description, by M. C. Cooke, of a new vine disease (*Glæosporium pestiferum*), received from Brisbane. (M. V.)

745. CUGINI, G., E MACCHIATI, L. **La Bacterosi dei grappoli della vite.** <Staz. Sper. Agr. Italiane, vol. XX, Giugno 1891 (18 Luglio), Asti, pp. 579–582.

Give preliminary report upon a bacterial disease of young grape clusters found in June, 1891, at several localities near Modena. The disease is manifested by a brown coloring and final drying up of the stems and pedicels of the young grapes and a consequent wilting of the immature berries. The organism (3–4 by 1–1½ μ), cultivated on gelatin, gives honey-yellow colonies with indefinite contours, which rapidly become confluent and liquefy the medium; also grows on potato, giving same colored colonies, but with sinuose margins. Find the bright yellow color to fade out upon extended cultivation in gelatin. No inoculations were reported on, but it is the intention of the authors to work out the life-history of the parasite. Think the malady likely to prove a most serious one. (D. G. F.)

746. DESPEISSIS, J. A. **Anthracnosis or black spot of the grape.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, July, 1891, pp. 421–424, figs. 2.

Speaks of the microscopic fungus causing the disease. Sums up results of experiments carried on near Bordeaux to test different substances as preventives. Recommends several washes and powders, and speaks of methods of applying. (M. V.)

747. DETMERS, FREDA. **Apple scab (Fusicladium dendriticum, Fckl.).** <Ohio Agric. Exper. Sta., 2d ser., vol. IV, Bull. No. 9, Columbus, Dec., 1891, pp. 187–192, pl. V–VII.

Gives a list of apples subject to attacks of disease and describes its features. Discusses external characters, effects on host, and microscopical characters. (See Exper. Sta. Rec., vol. III, April, 1892, p. 620.) (J. F. J.)

748. GALLOWAY, B. T. **A new pear disease.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 113–114.

Describes a disease observed in Alabama due to *Thelephora pedicellata* Schw. Recommends cutting out diseased wood, washing with copperas or sulphate of iron, and coating wounds with wax or similar substance. This treatment was successful when tried. (J. F. J.)

749. HALSTED, B. D. **Bacterial melon blight.** <Miss. Agric. and Mechanical Coll. Exper. Sta., Bull. No. 19, Agric. College, Jan., 1892, pp. 9–11.

Describes disease due to bacterial germs, and mentions successful experiments in transferring disease from cucumbers to squashes, tomatoes, and potatoes. It thus seems to be the same disease in all these plants. (J. F. J.)

750. HALSTED, B. D. **Treatment of cranberry scald and cranberry gall fungus.** <Jour. Mycol, vol. VI, Washington, May 14, 1890, pp. 18–19.

A general description of the diseases, with directions for treatment. (See No. 204.) (J. F. J.)

751. KERR, J. W. **Plum knots.** <Am. Farmer, 10th ser., vol. X, Baltimore, May 1, 1891, p. 102, ½ col.

Recommends cutting out diseased trees and planting varieties not subject to the disease. Advocates discarding Damson plums altogether. (J. F. J.)

752. MARTELLI, [N.] **[Ceppi di vite affetti dalla cosi detta tubercolosi.]** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, 6 Aprile, 1891, Firenze, p. 550 [350].

Report by the secretary of the Society of a note presented on a doubtful bacterial disease of the vine called tuberculosis, and the exhibition of slide, showing the organism of the tuberculosis of the olive. (D. G. F.)

753. MARTELLI, N. **Il black-rot sulle viti presso firenze.** <Nuova Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, 5 Ottobre, 1891, Firenze, pp. 604–610.

Discusses question of the presence of the black rot in Italy, deciding it to have made its first appearance in 1891, notwithstanding a previous report in 1877 by Arcangeli. Doubt is thrown on its correct identification by the fact that only the form on the leaf has been found. Refers to work of Viala, and especially to experiments of Galloway. (D. G. F.)

754. MORROW, J. D. **Fungi on fruit trees.** <Am. Farmer, 10th ser., vol. X, Baltimore, July 1, 1891, p. 149, 1½ cols.

A general statement of what fungi are. Advocates good cultivation and not too much dependence upon fungicides. (J. F. J.)

755. PAMMEL, L. H. **Fungous diseases of sugar beet.** <Iowa Agric. Exper. Sta., Bull. No. 15, Des Moines, [Ames] Nov., 1891, pp. 234–254, pl. I–VII.

Discusses various diseases of sugar beet observed both in Europe and America. These are beet rust, caused by *Uromyces betæ*; white rust of beets, caused by *Cystopus bliti*; spot disease, caused by *Cercospora beticola*; root-rot disease, caused by Nematode worms; violet-root fungus, caused by *Rhizoctonia betæ*, and also by species of bacteria; scab of beets, caused by bacterial germ as shown by Bolley. The life history of these species is given. In summary states that spot disease can be checked by Bordeaux mixture or ammoniacal carbonate of copper. Beet scab and potato scab seem to be the same, and the two crops should not follow one another. They are liable to be carried from a diseased field to one not infected. [Reprint of article repaged, 16 pp.] (J. F. J.)

756. PIERCE, N. B. **A disease of almond trees.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 66–77, pl. XI–XIV.

Describes the extent of the disease and the stocks affected. Gives an extended description of the general and special effects of the fungus and discusses the spread of the disease. Gives general directions for prevention, mainly the collection and burning of fallen foliage and turning in the soil beneath the trees. Many details of germination and life history of the fungus are also given. The disease is due to *Cercospora circumscissa* Sacc. (J. F. J.) (See Pacific Rural Press, vol. XLIV, Aug. 20, 1892, p. 141, fig. 9.)

757. PIERCE, NEWTON B. **Tuberculosis of the olive.** <Jour. Mycol., vol. VI, Washington, Apr. 30, 1891, pp. 148–153, pl. XIV, XV.

Refers to the presence of this disease in the Mediterranean region of Europe, and quotes description by Savastano. Probably due to presence of bacteria. Cutting off affected branches seems to be all that is necessary to prevent disease spreading and doing damage. (J. F. J.)

758. SMITH, ERWIN F. **Field notes, 1890.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 107–110.

Gives short notes on peach-leaf curl (*Taphrina deformans* Tul.); plum taphrina; plum blight, apple blight (*Bacillus amylovorus* (Burrill) Trev.); pear leaf-blight (*Entomosporium maculatum* Lév.); black rot (*Læstadia bidwellii* (Ell.) V. and R.); vine blight; brown rot of the peach (*Monilia fructigena*); peach yellows and peach rosette. (J. F. J.)

759. SMITH, ERWIN F. **Field notes, 1891.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 88–95.

Consists of notes on the following diseases: Peach curl, peach mildew, black spot of peaches, frosty mildew of peaches, peach rust, peach rot, peach yellows, clubbed branches of peach, stem and root tumors, peach rosette, pear diseases, and sycamore blight. (J. F. J.)

760. SMITH, ERWIN F. **Peach blight.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 36–39, pl. V, VI.

Describes appearance of disease and its manner of working on the tissues of plant. Penetrates the blossoms and then spreads to twigs. Gives results of experiments to secure fruiting specimens of the fungus (*Monilia fructigena*), and describes its effect upon the woody tissues. (J. F. J.)

761. SOUTHWORTH, E. A. **Ripe rot of grapes and apples.** <Jour. Mycol. vol. VI, Washington, April 30, 1891, pp. 164–173, pl. 1 (XV).

Gives general outline of history of the fungus (*Glœosporium fructigenum* Berkl.) which is the same as that producing bitter rot in apples. The external characters and microscopic characters are fully described. Under "treatment" gives the results of an experiment, showing that spraying with potassium sulphide and ammoniacal copper carbonate produced good results with apples. The same treatments would probably also protect grapes. (J. F. J.)

762. THÜMEN, FELIX. **Die Black Rot Krankheit der Weinreben (Phoma uvicola, Berk. and Curt.), Physalospora bidwellii (Sacc.).** <Allgemeinen Weinzeitung, Wien, 1891, pp. 1–29.

A general account of black rot of the grape, based for the most part on papers by American authors. (B. T. G.)

763. UNDERWOOD, L. M. **Diseases of the orange in Florida.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 27–36.

Gives notes on orange diseases, with mention of causes, distribution, and remedies. The diseases treated are die-back, foot-rot (Mal-di-Goma), blight, scab, leaf-spot, sooty-mold, and leaf-glaze. The last is due to growth of a lichen. (J. F. J.)

(See also, Nos. 704, 706, 716, 727, 765, 789, 832, 833, 838, 850, 854, 871, 897, 910, 976, and 995.)

IV.—DISEASES OF FOREST AND SHADE TREES.

764. [ANON]. **Dr. Mayr on the parasitic fungi of North American forest trees.** <Gard. and Forest, vol. V, N. Y., Jan. 27, 1892, pp. 37–38.

Refers to examination of original specimens of Dr. Mayr, and gives as conclusions that *Rhytisma punctiforme* Mayr is *R. punctatum* Fries. *Microsphæria corni* Mayr is *M. pulchra* Cke. and Pk. *Lophodermium infectans* Mayr and *Hysteriopsis acicola* are considered too imperfect to say more than that they belong to the order of Hysteriaceæ. No good reason exists for the genus *Hysteriopsis* Mayr. Examination of *Puccinidia abietis* Mayr shows that what is called the *uredospore* is not a *Uredo*, but a species of *Tuberculina*, which infects *Uredineæ*. Uncertainty exists as to whether the species is *T. persicina* or a closely allied species. A second parasite attacking the *Tuberculina* is stated to be what Mayr considered the teleutospores of the Æcidium, whose form is too indefinite to determine. (J. F. J.)

765. BAIL. **Verschiedene Mittheilung.** <Schrift. Naturf. Gesells. in Danzig, neue folge, 7 Bd. Danzig, 1891, pp. 22–25.

Mentions collection of *Melampsora gœppertiana* on *Vaccinium vitis-idæa* ("Preiselbeer"). Near Ilmenau, Thüringen finds *Sclerotinia baccarum* causing a disease of berries of *Vaccinium*; *Peziza willkommii*, causing canker of the larch; *Lophodermium brachysporum*, causing the falling of pine leaves. A few other species of fungi are commented on. (W. T. S.)

66. **Farlow, W. G.** Diseases of trees likely to follow mechanical injuries. [Boston, 1891, pp. 15.]

A paper read before the Massachusetts Horticultural Society, March 7, 1891, giving a statement of the structure of wood and the manner of healing of wounds. Refers also to the manner in which fungous germs find entrance into the wood and the bad effects likely to follow. (J. F. J.)

67 [**Meehan, T.**]. The European plane. <Meehan's Monthly, vol. II, Germantown, Pa., Jan., 1892, p. 11, ½ col.

Notes that in Ghent the European plane tree suffers from *Glœosporium nerviseguum*, the leaves falling from its effects early in autumn. Sulphate of copper recommended as a specific. (J. F. J.)

68. **Pasquale, F.** Rapporto al chiarissimo sig. Direttore del R. arsenale di artiglieria in Napoli sul legname di Pioppo attaccato da micro-organismi. <Nuovo Gior. Bot. Ital., (Bull. d. Soc.), vol. XXIII, Firenze, 8 Guinaio, 1891, pp. 184–186.

Gives preliminary note on a disease of poplar timber reported by the Director of the Artillery Arsenal at Naples, caused by a species of *Micrococcus*. Occurs in boards badly stacked, living in the wood vessels and causing yellow discolorations, and a final destruction of the tracheæ. Organism not cultivated. (D. G. F.)

69. **Vuillemin, Paul.** Remarques ètiologiques sur la maladie du Peuplier pyramidal. <Rev. Mycol., XIV, Toulouse, Jan. 1, 1892, pp. 22–27, pl. 1.

Describes a new fungus *Didymosphaeria populina* and discusses the relation to the disease of severe winters, vegetative reproduction, etc. (E. A. S.)

(See also, Nos. 727 and 759.)

V.—DISEASES OF ORNAMENTAL PLANTS.

70. **Arthur, J. C.** Carnation rust, a new and destructive disease. <Am. Florist, vol. VI, Chicago and New York, Feb. 18, 1892, pp. 587–589, fig. 4.

Refers to the recent observance of a carnation disease and its wide extent in the United States. Cause stated to be *Uromyces caryophyllinus*. Gives general history of fungus and suggestions for treatment. Bordeaux mixture and ammoniacal solution of copper carbonate, both effectual remedies. (See also, Cult. and Country Gent., vol. LVII, Mar. 10, 1892, p. 188, fig. 1; Garden and Forest, vol. V, Jan. 13, 1892, p. 18.) (J. F. J.)

71. **Galloway, B. T.** Disease of geraniums. <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 114–115.

States the disease is probably due to the presence of a *Bacillus*. Disease had been produced in several instances by inoculations directly from diseased plants. (J. F. J.)

72. **Halsted, B. D.** Fungous troubles in the cutting beds. <Gard. and Forest, vol. V, New York, Feb. 24, 1892, pp. 91–92.

States that diseases of various sorts have appeared on cuttings, particularly of the carnation, rose, clematis, passion flower, and chrysanthemum. In the carnation, due to species of *Colletotrichum;* in the rose, to a species of *Glœosporium;* in the chrysanthemum, to a species of *Septoria* or *Phyllosticta;* in Abutilon, to a species of *Colletotrichum*, probably identical with that on carnation; in nasturtium probably also the same species. (J. F. J.)

73. **Humphreys, Alfred.** The violet disease. <Am. Florist, vol. VII, Chicago and New York, Jan. 28, 1892, pp. 521–522.

Replies to C. D. Wadsworth that if an insect or a parasite is the cause of violets losing their leaves, is not that a disease? Mentions effects observed by himself on both violets and on celery. Gives method of cultivating the violet. (J. F. J.)

74. [**Meehan, T.**] Disease in Clematis. <Meehan's Monthly, vol. I, Germantown, Pa., Nov., 1891, p. 74, ½ col.

Refers to disease as probably of fungous origin, and recommends watering with a solution of copper, made by dropping pieces of blue copperas about the size of an egg in a barrel of water. Draw earth away from plant and form a basin, in which pour the solution to insure its reaching the "collar" of the plant, the point usually attacked by the fungus. (J. F. J.)

775. [**Meehan, T.**] Rhododendron disease. <Meehan's Monthly, vol. II, Germantown, Pa., Nov., 1891, p. 72, 1 col.

Refers to yellowing and dropping of leaves of Rhododendron. Thinks it may be due to attacks of *Agaricus melleus*, but more likely to an oversaturated soil. Recommends under draining. (J. F. J.)

776. [**Meehan, T.**] Violet diseases. <Meehan's Monthly, vol. II, Germantown, Pa., Jan., 1892, p. 8, ½ col.

Brief note on disease caused by fungi. Spraying with solution of sulphate of copper recommended. (J. F. J.)

777. S. ——. [**The violet disease.**] <Am. Florist, vol. VII, Chicago and New York, Jan. 28, 1892, p. 522, ⅓ col.

States trouble to spread most rapidly in weather with extreme and sudden changes of temperature. Believes careful cultivation will be effectual preventive. Notes similar trouble with chrysanthemums. (J. F. J.)

778. [SANDERS, EDGAR.] **The carnation rust.** <Prairie Farmer, vol. LXIV, Chicago, Mar. 5, 1892, p. 151, ¾ col.

Refers to paper by Arthur (see No. 770) and states that disease may be combated with sulphate of iron (¼ to ½ pound to a gallon of water), by Bordeaux mixture (probably), and by ammoniacal copper carbonate. (J. F. J.)

779. SOUTHWORTH, E. A. **Additional observations on anthracnose of the hollyhock.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 115-116.

States that a fungus similar to that of diseased hollyhocks has been found in Kansas on *Sida spinosa*. Thinks it probable the species should be known as *Colletotrichum* ... (Br. and Casp.). Notes also that *C. bromi* Jennings from Texas may be same as ... *graminicola* (Ces.) Sacc. (J. F. J.)

780. SOUTHWORTH, E. A. **A new hollyhock disease.** <Jour. Mycol., vol. VI., Washington, Sept. 10, 1890, pp. 45-50, pl. 1, (III.)

Describes damage occasioned by a new disease of Hollyhocks, caused by *Colletotrichum althææ* n. sp. Gives external and botanical characters and recommends Bordeaux mixture as a remedy. (J. F. J.)

(See also Nos. 843 and 971.)

D.—REMEDIES, PREVENTIVES, APPLIANCES, ETC.

781. ALWOOD, WILLIAM B. **Current notes.** <Southern Planter, 51st year, Richmond, Va., June, 1890, pp. 274-276.

Notes treatment of apple scab and black rot of grapes in Albemarle County, Va., and refers to fact that he prepared a bill against peach yellows which was passed with some amendment by the legislature. (D. G. F.)

782. ALWOOD, WILLIAM B. **Notes on treatment of grapes.** <Southern Planter, 52d year, Richmond, Va., May, 1891, p. 249, 1¼ col.

Gives instructions for treatment of grape diseases by use of ordinary copper compounds. (D. G. F.)

783. ALWOOD, WILLIAM B. **Standard fittings for spray machinery.** <Insect Life, vol. IV, Washington, Oct., 1891, pp. 58-59.

Brief report of committee appointed to confer with makers of spraying machines to secure standard sizes of styles and fittings for machines. (J. F. J.)

784. ALWOOD, WILLIAM B. **Treatment of black rot of grapes. Note on Bordeaux mixture—A modification of the copper carbonate preparation.** <Southern Planter, 51st year, Richmond, Va., Oct., 1890, p. 462, 2 cols.

Claims to have discovered that it required only 1¼ parts of quicklime to neutralize 1 part of copper sulphate and discovered independently of several French investigators that the formula might be reduced. Gives the reduced formula as 2 pounds of copper sulphate and 2½ pounds of lime. Claims priority in the preparation of the well known "Masson" mixture of copper carbonate from copper sulphate and sodium carbonate. Gives as date of discovery spring of 1888. [See Patrigeon, G. Prog. Ag. et Vit. 4 anné 3 Juillet, 1887, p. 17.] (D. G. F.)

785. [ANON.] **Apple scab.** <Am. Agric., vol. LI, New York, Feb., 1892, p. 139, ½ col.

Notes that "black mildew" of a correspondent is probably apple scab (*Fusicladium dendriticum*). Gives statement of how to treat disease, using solution of 4 pounds sulphate of iron to 4 gallons of water. (J. F. J.)

786. [ANON.] **Bordeaux mixture for potato diseases.** <Agric. Journ. Dept. of Agric. of Cape Colony, vol. IV, Cape Town, Jan. 14, 1892, p. 160, ½ col.

A paragraph credited to the *Standard* states that "unless the sulphate of copper is neutralized by the admixture of a sufficient quantity of good and fresh quicklime, it is injurious to vegetation." The mixture should show no acidity when tested by means of litmus paper. Equal proportions of lime and copper sulphate are recommended instead of one part of lime to two of copper sulphate as formerly advised. (W. T. S.)

787. [ANON.] **Machines and processes for destroying insect and fungus pests.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Feb., 1891, pp. 79-81.

A classification of machines and award of certificate of merit to manufacturer of the best machine. (M. V.)

788. [ANON.] **Mildew in grapes.** <Am. Agric., vol. L, New York, May, 1891, pp. 298-299, ½ col.

Refers to powdery and downy mildew, recommending for the former sulphuring and for the latter ammoniacal solution of copper carbonate. Gives formula for the same. (J. F. J.)

789. [ANON.] **Pear leaf-blight.** <Orange Judd Farmer, vol. XI, Chicago, Jan. 21, 1892, p. 5, fig. 2.

Quotes from report of Secretary of Agriculture in relation to value of ammoniacal copper carbonate solution for pear leaf-blight. Preferable to Bordeaux mixture because about as effectual and cheaper. Costs 3½ cents per tree for Bordeaux, against 2¼ cents per tree for copper carbonate solution. (J. F. J.)

790. [ANON.] **Poisons on fruit.** <Cult. and Country Gent., vol. LVII, Feb. 18, 1892, Albany, N. Y., p. 128, ⅔ col.

Discusses the use of fungicides containing copper and the liability of danger from use of fruit sprayed with them, concluding that there is really more copper in many articles commonly eaten than is found in sprayed grapes. (J. F. J.)

791. [ANON.] **Preventive for plum-rot.** <Am. Gardening, vol. XIII, New York, Mar., 1892, pp. 180-181, ⅙ col.

Directions for treating *Monilia fructigena*. Burn leaves, etc., in autumn; spray before buds open in spring with iron sulphate, and after flowers open spray with sulphide of potassium. (J. F. J.)

792. [ANON.] **Remedy for flea-beetle and blight [on potatoes].** <Am. Gardening, vol. XIII, New York, Mar., 1892, p. 180, ⅙ col.

States that Bordeaux mixture will prevent blight of potato, as may also ammoniacal solution of copper carbonate. Doubt expressed as to whether it will pay to treat vines. (J. F. J.)

793. [ANON.] **Rot among late potatoes.** <Am. Farmer, 10th ser., vol. X, Baltimore, Aug. 1, 1891, pp. 170-171, ⅔ col.

Recommends early planting and harvesting for prevention of rot. Bordeaux mixture and other copper compounds, together with London purple, will prevent the disease and kill insect pests at the same time. Article quoted from American Cultivator. (J. F. J.)

794. [ANON.] **Scabby pears.** <Cult. and Country Gent., vol. LVII, Albany, N. Y., Jan. 21, 1892, p. 47, ⅓ col.

Query as to cure for scabby pears answered by saying that fertilizing and manuring will not be effective. Spraying with copper solution has been tried, but without positive results. (J. F. J.)

795. [ANON.] **Sulphate of copper and lime for vine mildew.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Sept., 1891, p. 557.

Mentions the report of the British consul at Bordeaux, in which a reference is made to this subject. Says that numerous scientific analyses were made showing that the amount of copper in wine made from sprayed vines was so small that human health could not be injured by it. Another investigation was made a few months ago and confirmed this result. (M. V.)

796. [ANON.] **Sulphate of copper and the potato disease.** <Gard. Chron., 3d ser., vol. XI, Jan. 9, 1892, London, p. 50, ½ col.

States that experiments concluded last year by the Agricultural Society are described in detail in their journal. The remedy has not prevented the disease, but has lessened its amount. Advises early planting. (M. B. W.)

797. [ANON.] **The Strawsonizer.** <Agric. Gaz. N. S. Wales, vol. II, Sidney, Mar., 1891, p. 160.

Description of a machine designed for spraying with liquids or powders, sowing seed, and distributing manure. Gives account of trial made with it. (M. V.)

798. [ANON.] **The Strawsonizer.** <Agric. Gaz. N. S. Wales, vol. II, Apr., 1891, p. 224.

Notes tediousness of distributing sulphur on vines affected with *Oidium* by means of bellows, and says Strawsonizer sulphurs evenly and quickly, implying its value for sulphuring vines. (M. V.)

799. BARRY, W. C. **[Presidential address to the western New York Horticultural society.]** <Union and Advertiser, Rochester, N. Y., Jan. 27, 1892.

Under the head of "Insecticides and fungicides" refers to successful use of Bordeaux mixture in combating plant diseases. Carbonate of copper considered a remedy for apple scab (*Fusicladium dendriticum*). Reference is also made to presence of sulphate of copper and blue vitriol on grapes and the little danger from use of sprayed grapes. (J. F. J.)

800. BEACH, S. A. **Copper soils and vegetation.** <Cult. and Country Gent., vol. LVII, Albany, N. Y., Jan. 28, 1892, p. 68, 1 col.

Gives results of preliminary greenhouse experiments with peas and tomato seeds grown in soil containing 1 to 5 per cent of copper sulphate. Finds germination accelerated by presence of sulphate but maturity also hastened and plantlets dwarfed. Reports analyses from soil of old potato field showing presence of copper in distinct quantities. Concludes that nearly eleven hundred years would be required to impregnate to the extent of 1 per cent a layer of soil 1 foot deep by ordinary methods of spraying usually employed. (D. G. F.)

801. BERLESE, A. N., ed SOSTEGNI, L. **Osservazioni sull'idea di preservare la vite dal l'invasione della Peronospora mediante la cura interna preventiva con solfato di rame.** <Staz. Sper. Agr. Italiene, vol. XXI, Asti, Settem., 1891 (18 Ottobre, 1891), pp. 229-233.

Discuss results of two experiments with small quantities of soil treated with copper sulphate showing the sulphate to be decomposed in the soil and absorbed by it. Decide absorption power of calcareous soil to equal 46,822 Kg. of copper sulphate per hectare. Suggest that plants may absorb the copper in small quantities and inquire if this may not be turned to account in the treatment of diseases. (D. G. F.)

802. BUNZLI, J. H. **Combating the potato blight.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, pp. 78-79.

Gives experiments made with different fungicides. Concludes the best results were obtained from the use of Bordeaux mixture and copper-soda solution, the latter made with 4 pounds 6 ounces copper sulphate, 6 pounds 10 ounces soda, and 26 gallons of water. Plants should be sprayed twice. (J. F. J.)

803. BUTZ, GEO. C. **Implements and materials tested [in 1890].** <Penn. Agric. Ex. Sta., Bull. No. 14, State College, Jan., 1891, pp. 12-13.

Describes the "Victor" spraying pump, manufactured by the Field Force Pump Company, Lockport, N. Y. (J. F. J.)

804. CHARLES, M. P. **Les tomates sulfatées.** <Jour. Phar. et Chimie, 5^e ser., t. XXIV, Paris, 1891, p. 145.

Gives an account of a scare in France over the treatment of tomatoes by Bordeaux mixture. Shows that the amount is too small to be injurious and is found principally in the seeds of the fruit. Refers to the fact that bread, coffee, tea, and especially cocoa contain large amounts of copper, as does also liver of beef. Refers to action of prefect of police. (D. G. F.) (Reviewed in Staz. Sper. Agrarie Italiene, vol. XXI, fac. III, 1891, p. 291.)

805. CHESTER, F. D. **The copper salts as fungicides.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 21-24.

A statement of the constituents of Bordeaux mixture, eau celeste, eau celeste modified, and ammoniacal copper carbonate, with the chemical reactions of each. (J. F. J.)

806. COBB, N. A. **Notes on diseases of plants.** <Agric. Gaz. N. S. Wales, vol. II, Sydney, Aug., 1891, p. 492.

Speaking of apple scab (*Fusicladium dendriticum*) recommends eau celeste (modified) as a remedy. Recommends Bordeaux mixture as a preventive of strawberry leaf blight (*Sphærella fragariæ*). Under the subhead "Experiments with the Strawsonizer for prevention of wheat rust" gives suggestions as to method of using in experiment. (M. V.)

807. COSTE, H. **Instruction pratique sur les traitements à effectuer contre le mildew et l'anthracnose.** <Ann. Soc. d'hort. et d'hist. nat. de l'Hérault. 2 sér., tome XXIII, Montpellier, May and June, 1891, pp. 178-182.

The departmental professor of agriculture is sponsor for the following statements which occur in a work designed for general distribution. For grape mildew (*Peronospora*) the Bordeaux mixture has been found to give the most satisfactory results, but eau celeste, containing a part of the hydrated oxide of copper in an immediately soluble form, is a very active remedy, useful when vines are already attacked. Directions are given for making and applying Bordeaux mixture and eau celeste. If liquid fungicides are preferable, ordinarily, to powders, the latter may be of great service when the berries begin to be attacked. The two treatments may be combined, the Bordeaux or eau celeste being followed the day after by Skawinski, cupro-steatite, sulfo steatite, or sulphated sulphur—the first two on vines still free, the latter on vines already attacked. They should be applied mornings when dew is on, or quiet evenings. Anthracnose attacks principally the berries of Alicante Bouchet and Carignane. The Aramon, a variety which has heretofore remained almost exempt, is now one of the most attacked by punctate anthracnose. No radical remedy is known. Four have been used—sulphur, lime, cement, and gypsum. Employed separately they have some value, but are more efficacious when mixed in the following ways: (1) $\frac{1}{4}$ sulphur and $\frac{3}{4}$ lime of *Teil*. (2) $\frac{1}{4}$ sulphur and $\frac{3}{4}$ cement; (3) $\frac{1}{4}$ sulphur and $\frac{1}{2}$ lime of *Teil*, $\frac{1}{4}$ cement; (4) $\frac{1}{2}$ sulphur and $\frac{1}{2}$ lime of *Teil*, $\frac{1}{2}$ baked plaster. These mixtures should be used copiously in still evenings or mornings when there is dew. The following wash is recommended for use in the spring on vines already attacked: Dissolve 50 per cent sulphate of iron in warm water, after having wet the crystals with 1 per cent of sulphuric acid. The substance should be put on some days before vegetation begins with a brush or with a spraying machine. (E. F. S.)

808. CROZIER, A. A. **On the effects of certain fungicides upon the vitality of seeds.** <Jour. Mycol., vol. VI, Washington, Mar., 1890, pp. 8-11.

Gives results of experiments with blue vitriol on corn (a teaspoonful in half a saucer of water; also 5 pounds vitriol to 10 gallons of water); in both cases germination was retarded. Blue vitriol on wheat (5 pounds to 10 gallons of water) also had bad effect on germination. Copperas on corn was tried with a like injurious effect. The seed in these trials was soaked from ten minutes to twenty-four hours. (J. F. J.)

809. DIMMOCK, GEO. **Electricity in agriculture.** <Science, vol. 19, New York, Feb. 19, 1892, p. 109, $\frac{1}{2}$ col.

Refers to paper by C. Warner (see No. 867) and queries whether the copper in the electric wires rather than the electric current was the cause of the freedom from mildew. (J. F. J.)

10. DURAND ET GALEN. **Traitement du Mildiou par le verdet Gris.** <Montpellier, Ricard Fréres, 1892, pp. 12.

Present arguments in favor of the use of verdet or acetate of copper over Bordeaux mixture in the treatment of *Peronospora viticola*. (D. G. F.)

1. [EDITORIAL.] **"Poisoned" apples.** <Cult. and Count. Gent., vol. LVII, Albany, Feb. 18, 1892, p. 130, ¾ col.

Refers to fear in England of eating apples sprayed with copper preparations, and points out absurdity of belief in any danger from this source. (J. F. J.)

12. [EDITORIAL.] **[Sulphate of copper for potatoes.]** <Science Gossip, No. 317, London, May, 1891, p. 112, ½ col.

Notes sulphate of copper as an antidote for potato disease as well as inducing a heavier crop. (J. F. J.)

3. [FAIRCHILD, D. G.] **Sprayed fruit harmless.** <Democrat and Chronicle, Rochester, N. Y., Feb. 1, 1892.

An article prepared by a committee of the Western New York Horticultural Society, consisting mainly of an abstract of a paper by D. G. Fairchild. Reference is made to the presence of copper in many articles of common use as well as in sprayed grapes. Analyses show the maximum amount of copper to be ½ of a grain per pound of fruit. A summary of analyses made by Van Slyke is given, and the conclusion positively announced that it is impossible for a person to get enough copper from the fruit to be injurious to health. (J. F. J.)

14. FAIRCHILD, D. G. **The toxicology of the copper compounds when applied as fungicides.** <Union and Advertiser, Rochester, N. Y., Jan. 28, 1892.

Abstract of paper read before Western New York Horticultural Society, advocating use of Bordeaux mixture and ammoniacal solution of copper carbonate, and suggesting a reduction in amount of copper used in Bordeaux mixture, using 65 to 75 gallons of water [instead of 45] to 6 pounds of copper sulphate and 4 pounds of lime. (See Gard. and Forest, vol. V, Feb. 10, 1892, p. 71.) (J. F. J.)

15. GALLOWAY, B. T. **Cans't thou minister to a plant diseased?** <Rural New Yorker, vol. L, New York, Dec. 19, 1891, pp. 880–881.

Refers to early belief as to the origin of blights or mildews, and to the later investigations as to their causes. These were carried on especially by the Section of Vegetable Pathology established in 1885, and as a result the scientific farmer is able to conquer diseases which previously had wrought great havoc among his crops. (J. F. J.)

816. GALLOWAY, B. T. **Description of a new knapsack sprayer.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, pp. 51–59, figs. 10.

A detailed description of a new and low-priced knapsack sprayer, estimated to cost $10.87. Manufactured by Albinson & Co., Washington, D. C. (J. F. J.)

817. GALLOWAY, B. T. **Does it pay to spray?** <Am. Farmer, 10th ser., vol. X, Baltimore, Oct. 15, 1891, p. 232, 1½ cols.

Gives result of use of fungicides, especially Bordeaux mixture, for black rot, also for pear leaf-blight and scab. (J. F. J.)

818. GALLOWAY, B. T. **Notes on fungicides and a new spraying pump.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 25–26.

Gives a formula for preparation of copper acetate or verdigris; also one for a fungicide for downy mildew of grape. Announces that a new and cheap knapsack spraying pump will be put on the market in a few weeks. (J. F. J.)

819. GALLOWAY, B. T. **Suggestions in regard to the treatment of Cercospora circumscissa.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 77–78.

Gives methods of treatment based on experiments made on similar diseases in Australia. Recommends ammoniacal solution of copper carbonate in proportions of 5 ounces copper carbonate, 3 pints aqua ammonia, and 45 gallons of water. Details given as to method of applying fungicide and a recipe for making copper carbonate at home at expense of about 18 cents per pound. (J. F. J.)

820. GALLOWAY, B. T. **Treatment of black rot, brown rot, downy mildew, powdery mildew, and anthracnose of the grape; pear scab and leaf-blight, and apple powdery mildew.** <Jour. Mycol., vol. VI, Washington, Mar., 1890, pp. 11–15.

Gives statement of mode of treatment of diseases mentioned in title, with formulæ for various fungicides. (J. F. J.)

821. GALLOWAY, B. T. **Experiments in the treatment of plant diseases. Part III.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 12–16, fig. 1.

Gives details of experiments on grape diseases to determine the comparative value of various fungicides; the value of mixed treatment and value of early as compared with late sprayings. The conclusions were that Bordeaux mixture heads the list as a preventive against black rot; copper carbonate in suspension and milk of lime are comparatively useless; copper acetate is liable to injure the foliage, as is also mixture No. 5. Early sprayings are absolutely necessary to insure the best results. (J. F. J.) (For Parts I and II see Nos. 824 and 825.)

822. GALLOWAY, B. T. **Note [on paper by Newcombe on "Perennial mycelium of the fungus of blackberry rust"].** <Jour. Mycol., vol. VI, Washington, Jan. 1891, pp. 106–107.

Refers to value of treatment with fungicides for prevention of rust. Concludes it is indirectly beneficial and advocates grubbing up diseased plants. (J. F. J.) (See N…

823. GALLOWAY, B. T. **The improved Japy knapsack sprayer.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 39–41, pl. VII–IX.

Describes in detail an improved sprayer, estimating it to cost from $10 to $12. (J. F. J.)

824. GALLOWAY, B. T., and FAIRCHILD, D. G. **Experiments in the treatment of plant diseases. Part I.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. …

Describe treatment of black rot of grapes giving details of experiments made at … Va., to determine: (1) Best means of applying preparations; (2) relative value of B… mixture, ammoniacal copper carbonate solution, copper carbonate in suspension and … treatment of the first two; (3) actual cost of each treatment; (4) amount of copper … fruit. The amount of fruit saved by the various treatments varied from 93.54 per … 99.20 per cent. The expense varied from .0077 cent to .008 cent per pound of fruit. … clusion reached was that of the three treatments that with ammoniacal solution was most profitable. Give also report on diseases of the grape in western New York, the … object being to investigate "blight" or "rust." Give characters of disease with … suggestions for treatment. Underdraining and late pruning are suggested. Brief reference to other diseases. (J. F. J.)

825. GALLOWAY, B. T., and FAIRCHILD, D. G. **Experiments in the treatment of plant diseases. Part II.** <Jour. Mycol., vol. VI, Washington, April 30, 1891, pp. 137–142.

Give details of experiments on pear leaf-blight and scab with five different fungicides, viz: Bordeaux mixture, ammoniacal solution, copper acetate, mixture No. 5, and copper carbonate in suspension. The first two gave the best results, the Bordeaux mixture … considered the better. For pear scab the experiments indicate that the sprayings should be made very early and that Bordeaux mixture is most to be relied on. (J. F. J.)

826. GARDNER, H. **Viticulture. Statistics of grape growing and wine production in the United States.** <Census Bulletin, No. 38, Washington, Mar. 10, 1891, pp. 11.

Gives general statistics of grape culture in the United States and mentions successful use of the fungicides recommended by the Department of Agriculture for combating grape diseases. (J. F. J.)

827. GIRARD, AIMÉ. **Recherches sur l'adhérence aux feuilles des plantes et notamment de la pomme de terre des composés cuivriques destinés a combattre leurs maladies.** <Journ. d'Agric. Prat., 56 Année, t. I, Paris, Feb. 4, 1892, pp. 176–178.

Tests numerous compounds of copper as to their adhesive power when applied to the foliage of the potato as shown by analyses of treated leaves before and after submitted to artificial showers of rain. Concludes that Bordeaux mixture (2 kg. cop. sulphate and 2 kg. lime) adheres better than the same mixture with double amount of lime; that the … soda mixture and copper acetate possess adhesive power double that of Bordeaux, and the Perret mixture (copper sulphate, lime, and molasses) showed remarkable adhesive properties, while Bordeaux mixed with clay (aluminium compounds) did not adhere so well as standard Bordeaux. (D. G. F.) (See also Comp. Rend., Paris, Feb. 1, 1892, pp. 234–…; Exper. Sta. Record, vol. III, May, 1892, p. 734.)

828. GOFF, E. S. **Treatment of apple scab.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 19–21.

Recommends solution of copper carbonate in ammonia and gives directions for preparing and using the fungicide. Also describes apparatus for spraying. (J. F. J.)

829. GOFF, E. S. **Treatment of fungous diseases.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 17–25, fig. 2.

Gives details of experiments for the prevention of apple scab, using copper carbonate dissolved in ammonia and in suspension in water; sulphur powder, and mixture No. 5 (ammoniated copper sulphate and ammonium carbonate). The results were mostly negative, but mixture No. 5 was most efficient. Details of treatment of *Septoria* of raspberry and blackberry are given, and show that the foliage of the raspberry is too delicate to stand applications of a corrosive nature. Foliage of blackberry is more resistant than raspberry and less so than that of apple. Ammoniacal copper carbonate solution can be used on blackberry, but not on raspberry. The use of Bordeaux mixture for potato rot was successful. (J. F. J.)

830. GREEN, W. J. **The spraying of orchards.** <Ohio. Agric. Exper. Station, 2d Ser., vol. 4, Bull. No. 9, Columbus, Dec., 1891, pp. 193–219, pl. VIII–XIII, 1 diagram.

Gives an account of experiment to prevent apple scab undertaken to ascertain (1) compounds to be used; (2) time to make application; (3) compound best adapted to be used with insecticides, and (4) profit in spraying. Five fungicides were used, viz, ammoniacal copper carbonate, modified eau celeste, dilute Bordeaux mixture, precipitated carbonate of copper, and ammonia copper solution. Of these dilute Bordeaux mixture gave the best results. Gives details of relative efficacy of fungicides, cost of spraying, effect of scab on the fruit, value of spraying to prevent scab, size of apples as effected by spraying, market value of apples, time and machinery for spraying. Found Paris green and dilute Bordeaux mixture together acted as both fungicide and insecticide. Discusses also spraying to prevent pear scab. Dilute Bordeaux mixture and modified eau celeste being about equally beneficial, but the latter

injured the foliage. For "shot-hole" fungus of the plum (*Septoria cerasina*) dilute Bordeaux mixture was found beneficial. Gives directions for making fungicides and a short list of manufacturers and dealers in spraying machinery. Gives a summary of the bulletin on last page. (See Exper. Sta. Record, vol. III, April, 1892, p. 620.) (J. F. J.)

31. GREINER, T. **(1) Comments on current agricultural literature. (2) The New York grape scare.** <Farm and Fireside, vol. xv, Springfield, Ohio, Dec. 15, 1891, p. 2.

(1) Thinks that Bordeaux mixture will soon "play out." It has various objections: (*a*) it is expensive; (*b*) it is troublesome to prepare and apply; (*c*) it has to be strained; (*d*) it is apt to clog the nozzle. Recommends the ammoniacal solution for all diseases. Advises fruit growers to study these questions so as to be prepared to spray in the proper way next year. (2) Says that grape growers were as much to blame as the New York Board of Health. The grapes should not have been sprayed so late, and if sprayed late the ammoniacal solution should have been used. (B. T. G.)

32. HALSTED, B. D. **Experiments for the year upon cranberry diseases.** <11th Ann. Rept. N. J. Agric. Ex. Sta., New Brunswick, 1891, pp. 332–339.

(1) Gives results of winter treatment of cranberry bog attacked by gall fungus (*Synchytrium vaccinii* Th.), showing good effects from keeping the bog dry. Gives copy of New Jersey State law for the eradication of dangerous plant diseases passed with special reference to the affected bog. (2) Gives results of several experiments with fungicides in the treatment of cranberry scald, using sulphur, sulphate of copper, sulphate of iron, air-slaked lime, common salt, carbonate of lime, modified eau celeste, sodium hyposulphate, sulphate of potash, ammoniacal solution of copper carbonate and Bordeaux mixture. Finds that heavy applications—1½ to 10 pounds of copper sulphate per square rod of bog, 3 to 20 pounds of iron sulphate, 3 to 20 pounds of sulphur—not only did not prevent disease but actually killed the vines, while mixed applications of sulphur and lime, sulphur and sulphate of copper, lime and sulphate of copper, and carbonate of lime, did not injure the vines in proportion of 2 to 10 pounds of each salt per 4 square rods of bog, but checked the scald only partially. Reports negative results from a test of ten substances named above in the proportion of 10–5–3½–1½ pounds per 25 square feet of bog. Reports a successful use by Mr. Goldsmith of layer of loam or sand applied to bog. (D. G. F.)

833. HALSTED, B. D. **Fungous diseases and their remedies.** <Amer. Agric., vol. LI, New York, Jan., 1892, pp. 34–35.

Briefly describes methods used for prevention of fungous diseases by spraying, soaking seed, etc. Gives credit to Department of Agriculture for work accomplished. (J. F. J.)

834. HALSTED, B. D. **[Remarks on spraying.]** <Ann. Rept. N. J. State Board of Agric., vol. XVIII, Trenton, 1891, pp. 100–102.

Advocates spraying for prevention of plant diseases. (J. F. J.)

835. HALSTED, B. D. **Treatment of grapevines.** <Cult. and Country Gent., vol. LVI, Albany, N. Y., July 16, 1891, p. 576.

Review of Farmers' Bulletin No. 4. of U. S. Department of Agriculture, giving directions for treatment of grape vines for prevention of downy and powdery mildew, anthracnose and black rot. (D. G. F.)

836. HARVEY, F. L. **Spraying experiments—apple scab.** <Ann. Rept. Maine Agric. Ex. Sta., part IV, Orono, Dec. 31, 1890, (1891), p. 113.

Mentions failure to carry out expected experiment with apple scab. (D. G. F.)

837. HATCH, A. S. **[Notes on apple scab and potato rot.]** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 26–27.

Gives additional notes on the experiments conducted by Prof. Goff, mentioning effects of spraying on the foliage of apple, raspberry, and blackberry. Describes also manner of treating potatoes with Bordeaux mixture for blight. This was also effective against Colorado potato beetle. (J. F. J.)

838. HOWARD, CHAS. H. **Spraying fruit.** <Farm, Field, and Stockman, vol. xv, Chicago, Feb. 6, 1892, p. 127.

Notices a review of paper read before Illinois State Horticultural Society for 1892. Partially successful use of copper sulphate and soda in prevention of rot of grapes. (D. G. F.)

839. KELLERMAN, W. A., and SWINGLE, W. T. **Prevention of smut in oats and other cereals.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 26–29.

Gives outline of treatment to be used. This is by means of hot water. (See for further details Nos. 156, 157, 291.) (J. F. J.)

840. KINNEY, L. F. **The potato scab.** <Rhode Island State Agric. Exper. Sta., Bull. 14, Kingston, Oct., 1891, pp. 175–187, figs. 3.

Gives an account of the characters and cause of the disease from Bolley and Thaxter, and details of experiments for its prevention. Seaweed used to cover the seed potatoes checked the disease, while stable manure scattered in the furrows or over the seed was favorable to its development. Spraying the seed in the furrows with Bordeaux mixture before covering with earth gave a product almost free from scab, and was more effectual than the sprayings of the vines with the same fungicide. Spraying with Bordeaux mixture also gave good results in the prevention of potato blight and rot. (See Exper. Sta. Record, vol. III, Apr., 1892, p. 623; Gard. Chron., London, June 11, 1892, p. 758.) (J. F. J.)

841. M[ARLATT], C. L. **A cheap spraying apparatus.** <Insect Life, vol. III, Washington, Aug., 1890, pp. 38–39, fig. 1.

Describes and figures an apparatus designed by R. Thaxter for using fungicides and insecticides. (J. F. J.)

842. MASSEY, W. F. **The Bordeaux mixture.** <Am. Farmer, 10th ser., vol. X, Baltimore, June 15, 1891, p. 137, ½ col.

Mentions use of Bordeaux mixture as a fungicide. (J. F. J.)

843. MAYNARD, S. T. **Treatment of mildews upon plants under glass.** <Jour. Mycol., vol. VI, Washington, Mar., 1890, pp. 16–18.

Gives summary of results of experiments on rose and lettuce mildew. For both recommends evaporated sulphur under proper conditions. (J. F. J.)

844. MCCLURE, C. W. **Fungicides.** <Trans. Ill. State Hort. Soc., new ser., vol. XXV, Warsaw, Dec. 8–10, 1891, pp. 239–243.

Gives popular instructions for preparation and application of common fungicides. (D. G. F.)

845. MEEHAN, JOS. **Bordeaux mixture for pear blight.** <Cult. and Country Gent., vol. LVII, Albany, N. Y., Jan. 14, 1892, p. 28, ½ col.

Gives successful result from use of Bordeaux mixture for leaf-blight. Gives formula as 1 pound sulphate of copper, 1 pint ammonia to 22 gallons of water. This also used with success for black spot of roses. (J. F. J.)

846. [MEEHAN, T.] **Blackberry rust.** <Meehan's Monthly, vol. I, Germantown, Pa., Aug., 1891, p. 27, ½ col.

Notes presence of red rust on blackberry and raspberry leaves during summer at East Stroudsburg, Pa. Cutting out and burning recommended. (J. F. J.)

847. [MEEHAN, T.] **Bordeaux mixture.** <Meehan's Monthly, vol. II, Germantown, Pa., Jan., 1892, p. 10, ½ col.

Does not consider lime necessary in preparing Bordeaux mixture. (J. F. J.)

848. [MEEHAN, T.] **Sulphate of iron.** <Meehan's Monthly, vol. I, Germantown, Pa., Nov., 1891, p. 74, ½ col.

Refers to use of copper as a fungicide, stating that both sulphate of iron (green copperas) and sulphate of copper (blue copperas) are useful to destroy fungi. (J. F. J.)

849. MENOZZI, A. **Appunti alla comunicazione preventiva dei Proff. A. N. Berlese ed L. Sostegni "Osservazioni sull' idea di preservare la vite dall'invasione della Peronospora mediante la cura interna preventiva con sulfato di rame."** <Staz. Sperim. Agr. Italiene, vol. XXI, Nov., 1891 (Dec. 20, 1891), Asti, pp. 466–467.

Discusses article by Berlese and Sostegni in September number (see No. 801) expressing the opinion that the reaction taking place in the soil upon the addition to it of copper sulphate is not similar to that which takes place in case of the Bordeaux mixture, but more probably that the copper sulphate behaves like sulphate of potassium or sulphate of ammonium. Refers to work of Gorup Besanez (Ann. der Chem. u. Pharm., Bd. 127, p. 251) and Nobbe (Land. Vers. Stat., Bd. 15, p. 273), not mentioned by Berlese & Sostegni. (D. G. F.)

850. MILLARDET ET GAYON. **Nouvelles Observations sur l'efficacité de diverses bouillies dans le traitement du mildiou.—Sulfostéatite.**—<Journ. d'Agric. Prat., 56 année t. I. Paris, Feb. 18, 1892, pp. 231–239.

Gives results of experiments in treatment of *Peronospora viticola* in various localities in France testing the following fungicides: (1) Bouillie bordelaise céleste [principally sulphosaccharate of copper]; (2) Bouillie céleste à poudre unique [Sulphosaccharate of copper mixed with sulphate of copper and carbonate and bicarbonate of soda 2 kg. per hectolitre of water]; (3) Bouillie au sulphate d'ammonique [Bordeaux mixture: 1 kg. copper sulphate + 500 gr. lime + 400 gr. ammonium sulphate + 1 hectolitre of water]; (4) Bouillie bordelaise au sporivore Lavergne [Bordeaux mixture with addition of sporivore 1 kg. 500 gr. copper sulphate, 1 kg. 500 gr. lime, to which is added 1 kg. of sporivore, prepared by M. Lavergne, heated previously in 1 hectolitre of water]; (5) Bouillie bourguignonne [1 kg. 500 gr. copper sulphate, 2 kg. 250 gr. sodium carbonate crystals in 1 hectolitre of water prepared warm]; (6) Bouillie berichonne [same formula with addition of 25 centilitres ammonia 22 per cent]; and (7) ordinary Bordeaux [1 kg. 500 copper sulphate, 500 gr. lime in 1 hectolitre of water.] Although the results of the several experiments varied somewhat the author concludes that the mixtures containing a small amount of copper in solution as Nos. 1, 2, 3, and 6 gave no better results than those containing the copper in insoluble form. Reports from use of No. 3 serious injury to the foliage. Decides that the ordinary Bordeaux mixture using only 1 kilogramme of copper sulphate per 100 litre of water is not strong enough to prevent severe attacks of mildew. Closes with accounts of favorable results obtained with use of sulphosteatite. (D. G. F.)

851. NESSLER, J. **Copper-soda and copper-gypsum as remedies for grape mildew.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, pp. 73–74.

Describes methods of preparing the solutions and recommends spraying rather than using a dry powder. (J. F. J.)

852. PARMLY, J. C. **Copper solutions and soils.** <Cult. and Count. Gent., vol. LVII, Albany, N. Y., Mar. 10, 1892, p. 184, ½ col.

Refers to article by S. A. Beach (see No. 800) and advocates use of sawdust or some similar material to catch the poisonous substances used in spraying. (J. F. J.)

853. PENNY, C. L. **Several articles of food known to be healthful found to contain small quantities of copper.** <2d Ann. Rept. Del. College Agr. Ex. Sta., Newark, 1889, pp. 172–174.

Establishes presence of copper in grapes that have been treated with Bordeaux mixture and afterward washed with dilute vinegar, as also in grapes receiving no treatment, *i. e.*, natural; gives analyses of molasses, oatmeal, flour, beef liver, and New Orleans syrup. The number of parts of copper per million varies from 0.86 in flour to 58.85 in beef liver. Treated grapes contain from 2.4 to 6.23 parts per million, an amount little exceeding that in baking molasses or oatmeal, and less than one-ninth that found in beef liver. (D. G. F.)

854. RATHAY, EMERICH. **Bericht über eine im hohen Auftrage Seiner Excellenz des Herrn Ackerbau Ministers in Frankreich unternommene Reise zur Nachforschung über die Rebkrankheit Black Rot.** <Wien, 1891, pp. 20, fig. 7.

Gives a report of a visit made by the French Minister of Agriculture and several scientists to southern France in order to investigate the black rot fungus. The vines near Val Marie were first examined, this being the place where black rot was first discovered in France. Despite the most energetic efforts by the Government extending over a period of five years the disease still exists in this region. The report concludes by saying that black rot occurs sporadically throughout southern France, that no satisfactory remedy for it has been found, and that owing to its affecting green wood, its transportation on half-matured cuttings is made highly probable. (B. T. G.)

855. RILEY, C. V. **The outlook for applied entomology.** <Insect Life, vol. III, Washington, Jan., 1891, pp. 181–210.

Although devoted mainly to entomology, mention is made (pp. 192–195) of machines for using fungicides and insecticides, among them the Japy and Galloway sprayer and the Strawsonizer. Reference is also made (pp. 197–198) to contagious diseases of insects, the statement being that the best results so far obtained have been with the *Entomophthora* of the chinch bug. Gives brief mention of method of studying these diseases. (J. F. J.)

856. [ROOSEVELT, GEORGE W.] **[Experiment on potatoes in Belgium.]** <Report of Statistician U. S. Dept. of Agric., new ser., No. 92, Washington, Jan. and Feb. [Feb. 12], 1892, p. 27.

A quotation from a report by Consul Roosevelt mentioning successful use of Bordeaux mixture in combating potato rot. The plat treated yielded 21,500 kilograms to the hectare, while that untreated yielded only 6,900 kilograms to the hectare. (J. F. J.)

857. ROSTRUP, E. **Destruction des cryptogames nuisibles.** <Rev. Mycol., vol. XIV, Toulouse, Jan. 1, 1892, pp. 29–33.

Divides injurious fungi into two classes—one which can be controlled by the individual farmer independently of his neighbors, and another which requires concerted action to eradicate. In the first class the author includes smuts of grain, *Plasmodiophora brassicæ*, *Rhizoctonia violacea*, *Sclerotinia trifoliorum*, and *Phoma sanguinolenta*. In the second class are *Phytophthora infestans* and the *Uredineæ*. For the latter he recommends legislation which shall have for an end the disinfection of seed, destruction of hosts which produce any form of rust that will infect economic plants, and the hindrance to the introduction of fungous diseases by plants or seeds from countries where diseases exist. (E. A. S.)

858. S[MITH], H. W. **Mixtures for grape diseases.** <Am. Gardening, vol. XIII, New York, Feb., 1892, p. 114, ¼ col.

Gives formulæ for Bordeaux mixture and ammoniated copper carbonate solution. (J. F. J.)

859. [SMITH, H. W.] **Prevention of plum knot.** <Am. Gardening, vol. XIII, New York, Feb., 1892, p. 116. ⅛ col.

Recommends cutting out diseased branches. Spraying with ammoniacal solution may check disease. (J. F. J.)

860. [SMITH, H. W.] **Rose mildew.** <Am. Gardening, vol. XIII, New York, Feb., 1892, p. 115, ⅛ col.

Recommends as a preventive ½ ounce hyposulphite of soda to 10 gallons water; ammoniacal solution of copper carbonate also recommended. (J. F. J.)

861. STAHL, JOHN M. **Spraying in western Illinois.** <Cult. and Country Gent., vol. LVI, Albany, Sept. 3, 1891, p. 716, 2 cols.

Gives popular account of successful use of remedies against grape diseases by the Nauvoo Fruit Growers' Association. (D. G. F.)

862. STAHL, WM. **Black rot and mildew.** <Fla. Disp., Farmer and Fruit Grower, new ser., vol. III, Jacksonville, Jan. 8, 1891, p. 25, 3 cols.

Extract from circular of manufacturers of spraying machinery. (D. G. F.)

863. STEBBINS, C. W. **Pear blight.** <Fla. Disp., Farmer and Fruit Grower, new ser., vol. IV, Jacksonville, Mar. 3, 1892, p. 163, ⅛ col.

Says blight was cured by sprinkling tree with copperas and water, a tablespoonful to a bucket of water. Some also put on ground and hoed in. (Quoted from "National Stockman.") (J. F. J.)

864. SWINGLE, W. T. **Treatment of smuts of oats and wheat.** <U. S. Dept. Agric., Div. of Veg. Path., Farm. Bull. No. 5, Washington, Feb., 1892, pp. 8, pl. 1.

Describes the smuts of grain and gives an estimate of amount of damage resulting from the diseases. Gives directions for treatment, consisting mainly of immersing seed in hot water at a temperature of 132° to 135°. This is known as the Jensen treatment. Potassium sulphide for oats and copper sulphate for wheat also noticed. Short bibliography given on p. 8. (See also Agric. Jour. Cape Colony, vol. v, May 5, 1892, pp. 3–5.) (J. F. J.)

865. VAN SLYKE, L. **Results of analyses of some substances used in spraying.** <Cult. and Country Gent., vol. LVII, Albany, N. Y., Feb. 18, 1892, p. 128, 1 col.

States that a can of "Copperdine" contained only 8¾ oz. of copper sulphate, equal to 4 oz. copper carbonate and 28 oz. ammonium carbonate. Cost was about 29 cents. A sample of dry Bordeaux contained 11.62 per cent of copper instead of 15.24 per cent, as it should have done. Gives tests for determining the purity of copper sulphate, copper carbonate, and Paris green. (J. F. J.)

866. VAN SLYKE, L. **The adulteration of copper mixtures.** <Gard. and Forest, vol. v, New York, Feb. 24, 1892, pp. 90–91.

A summary of conclusions given in a paper read before the Western New York Horticultural Society, mentioning tests for determining purity of various fungicides. (J. F. J.)

867. WARNER, CLARENCE D. **Electricity in agriculture.** <Science, vol. XIX, New York, Jan. 15, 1892, pp. 35–37.

Refers to the experiments made to show the influence of electric currents upon the growth of plants. Gives details of experiments made at Hatch Experiment Station, Amherst, Mass., on lettuce to ascertain effects of an electric current on prevention of mildew. The result was that the largest heads were over the greatest number of wires and nearest the electrodes; five out of fifteen died of mildew in treated bed. It was found that the healthiest and largest plants, as soon as the current became feeble or ceased altogether, began to be affected with mildew. In beds without electric currents only three plants out of fifteen had partially developed, and only one was free from disease. In another experiment only five out of twenty plants were unaffected by mildew in the treated bed, while out of twenty plants in an untreated bed all but one died from mildew before half grown, and that one was badly diseased. The conclusion is that "those plants subjected to the greatest electrical influence were hardier, healthier, larger, had a better color, and were much less affected with mildew than the others." Grasses were experimented with, but without marked results. (See also, Bull. No. 16, Mass., Hatch Ex. Sta., Jan., 1892, pp. 8; Scient. Am. Supplement, vol. XXX, Feb. 13, 1892, pp. 13436–13437; Am. Agric., vol. LI, Mar., 1892, p. 201, ½ col.; Exper. Station Rec., vol. III, Washington, Mar., 1892, pp. 517–520; Gard. and Forest, vol. v, Jan., 27, 1892, pp. 47–48.) (J. F. J.)

868. WEED, C. M. **Spraying crops: Why, when, and where.** <Rural Publishing Co., New York, 1892, pp. 108, illustrated.

Brief directions for combating some common insect and fungous pests. (B. T. G.)

(See also, Nos. 665, 670, 673, 684, 696, 697, 698, 703, 704, 706, 707, 710, 716, 717, 719, 720, 721, 723, 724, 726, 729, 734, 739, 740, 742, 743, 744, 746, 748, 750, 751, 754, 755, 756, 757, 761, 766, 770, 774, 775, 777, 778, 780, 871, and 885.

E.—PHYSIOLOGY, BIOLOGY, AND GEOGRAPHICAL DISTRIBUTION.

869. ACLOQUE, A. **Les champignons au point de vue biologique, économique et taxonomique.** <Paris, 1892, pp. 327, figs. 60.

The book is divided into thirteen chapters, the first of which treats of the nature of fungi. Chapters 2, 3, and 4 discuss anatomy, and 5, 6, 7, 8, and 9 deal with physiology of the fungi. In the tenth, eleventh, and twelfth chapters fungi from an economic standpoint are considered. The thirteenth and last chapter is devoted to classification, the systems of Tournefort, Micheli, Bulliard, Persoon, Link, Nees, Fries, and Léveille being briefly reviewed. Berkeley's system receives considerable attention, while Bertillon's is given in full. (B. T. G.)

870. [ANON.] **Parasitic fungus on locust.** <Mediterranean Nat., vol. I, Malta, Aug. 1, 1891, p. 44, ¼ col.

Refers to experiments of Signor Trabut in Algiers, where *Botrytis acridiorum* has been found to destroy great numbers of locusts. Experiments are being made with a view of cultivating the parasite. (J. F. J.)

871. [ANON.] **Procès-verbaux, séance du 10 mai 1891.** <Ann. Soc. d'hort. et d'hist. nat. de l'Hérault, 2 sér., tome XXIII, Montpellier, May and June, 1891, p. 129.

MM. Sahut, Cathala, Barthélémy, Cachet, Gauzy, and Giardin were unanimous in declaring that abrupt variations of temperature are very favorable to the spread of the peach curl, *Exoascus deformans* Berk. M. Sahut stated that three methods of prevention had been tried, the Bordeaux mixture, decoctions of tobacco, and removal of the affected leaves. None of them were very successful. In 1890 the grape mildew (*Peronospora*) was not observed during the summer, and from May to September there was also an almost complete absence of dew. On the contrary, during September dew occurred on twelve days and there was an invasion of mildew. M. Galzin had found carbonate of soda better than lime for fixing copper sulphate. (E. F. S.)

872. BOARDMAN, E. R. **The cabbage worm disease.** <Insect Life, vol. III, Washington, June, 1891, pp. 409–410.

Gives account of spread of disease "Muscardine," destroying worms infecting cabbages. (J. F. J.)

873. BOLLEY, H. L. **Wheat rust—is the infection local or general in origin?** <Agric. Science, vol. v, Nov. and Dec., 1891, La Fayette, Ind., pp. 259–264.

Gives result of inquiries and details of experiments made to ascertain whether wheat rust mycelium persists in the tissues of host plants through the winter, and at what time the rust appears on the grain. Does not think spraying will be effectual in preventing rust. The uredospores are the chief agents of infection and may be carried for miles through the air without loss of vitality, and the general infection of fields throughout the country is thus accounted for. (J. F. J.)

874. BOURQUELOT, EM. **Matières sucrées contenues dans les champignons.** <Bull. Soc. Mycol., France, vol. 7, fasc. 4, Paris, Dec. 31, 1891, pp. 222–232.

Mannite was found in the following: *Psalliota arvensis* Schæff., young; *Tricholoma album* Schæff., adult; *T. sulfureum* Bull., young, adult; *T. resplendens* Fr., adult; *Lepiota excoriata* Schæff., young; *Hydnum repandum* L., young, adult; *H. squamosum* Schæff., adult; *Clavaria pistillaris* L., adult; *C. formosa* Pers., young. Trehalose was found in the following: young, *Hypholoma elæodes* Paul., *H. capnoides* Fr., *Stropharia æruginosa* Curt., *Flammula alnicola* Fr., *Hebeloma sinapizans* Fr., *H. crustuliniforme* Bull., *Claudopus variabilis* Pers., *Pleurotus ostreatus* Jacq., *Mycena polygramma* Bull., *M. galericulata* Scop., *Collybia longipes* Bull., *Clitocybe inversa* Scop., *C. geotropa* Bull., *Tricholoma cinerascens* Bull., *Lepiota excoriata* Schæff., *Amanita strobiliformis* Vitt., *A. nitida* Fr., *Bolbitus hydrophilus* Fr., *Coprinus micaceus* Bull., *C. atramentarius* Bull., *Cortinarius obtusus* Fr., *C. imbutus* Fr., *C. psammocephalus* Bull., *C. armillatus* Fr., *C. torvus* Fr., *C. cinnamomeus* L., *C. sublanatus* Sow., *C. elatior* Fr., *C. cœrulescens* Schæff., *C. glaucopus* Schæff., *C. variicolor* Pers., *C. cyanopus* Secret., *C. crocolitus* Quel., *C. argutus* Fr., *Hydnum repandum* L. (E. A. S.)

875. BOURQUELOT, EM. **Sur la présence de l'amidon dans un champignon appartenant à la famille des Polyporées, le Boletus pachypus, Fr.** <Jour. Pharm. et chimie, 5e sér., t. XXIV, Paris, Sept., 1891, pp. 197–199.

Reports presence in the cells of the pseudoparenchyma of *Boletus pachypus* of a substance which gives starch reaction with iodine. This substance appears to be in an insoluble state apparently as an impregnation of the membrane. Refers to work of Belzung and L. Rolland on the subject. (D. G. F.)

876. BOURQELOT, EM. **Sur la répartition des matières sucreés dans le cèpe comestible (Boletus edulis, Bull.) et le cèpe orangé (Boletus aurantiacus, Bull.).** <Jour. Phar. et Chimié, 5e sér. t. XXIV., Paris, Dec. 15, 1891, pp. 521–524.

Gives analyses of stipe, pileus and tubes of the hymenium of *Boletus aurantiacus* Bull. and *B. edulis* Bull. Finds that the stipe and pileus of these species alone contain the starch glucose or *mannite*, while the tubes of the hymenium remain free from these reserve materials. Reasons that these reserve materials are not present in this portion because consumed in the manufacture of the spores. Thinks this also explains the absence of dipterous larvæ from the hymenium. Refers to previous work on subject. (See ser. 5, t. XIX, p. 369; t. XXII, 413, 497. (D. G. F)

877. BREFELD, OSCAR. **Recent investigations of smut fungi and smut diseases.** <Jour. Mycol., vol. VI, Washington, May 14, 1890. pp. 1–8; Sept. 10, 1890, pp. 59–71; April 30, 1891, pp. 153–164.

A translation of an address delivered in Berlin before the Society of Agriculturists in February, 1888. Deals with the nature of parasites causing smut, their mode of development, methods of cultivation, manner of infection, and general life history. (J. F. J.)

878. CAVARA, F. **Note sur le parasitisme de quelques champignons.** <Rev. Mycol., vol. XIII, Toulouse, Oct., 1891, pp. 177–180.

Cites the following instances of fungi, which usually live as saprophytes, becoming parasitic to such an extent as to be decidedly injurious to vegetation: *Botrytis vulgaris* on branches of *Citrus*, *Dahlia*, and *Pelargonium zonale; Botrytis* n. sp. on *Tulipa gesneriana; Cladosporium herbarum* on raspberry, *Cycas revoluta, Fourcroya gigantea, Agave americana, A. salmiana*, and *A. rigida; Polyporus ulmarius* on elm roots. (E. A. S.)

879. CHARRIN, A. **La nature des sécrétions microbiennes.** <Rev. Gén. Sci. pure et appliq., 2 ann., Paris, Mar. 15, 1891, pp. 129–134.

General discussion of the subject. (E. F. S.)

880. CONSTANTIN, J. **Étude sur la culture des basidiomycètes.** <Rev. Gén. d. Bot., t. 3, Paris, Dec. 15, 1891, pp. 497–511, pl. 1.

After discussing in a general way the well-known methods of ancient and modern mushroom culture the author gives the results of his investigations upon the cultivation in nutrient media of *Nyctalis lycoperdoides* and *Marasmius oleæ*. Succeeded in producing from chlamydospores fully developed specimens of *Nyctalis*, with mature basidia, in this regard surpassing Brefeld in his cultivations of the same species. Uses as nutrient substrata upon which to grow the first species sterile slices of potato dipped in orange juice, slices of carrot, slices of turnip, leaves of the oak and beech, and fragments of other basidiomyceteous fungi. Finds the behavior of *Nyctalis* upon various substrata as indicative of the uncertain ground upon which *N. caliginosa, N. nauseosa*, and *N. microphylla* stand and reports the variation under different conditions of nourishment as very great. Finds, contrary to Brefeld, that spores of *Nyctalis* germinate easily upon the most diverse media and the parasitism of the species hinted at by Brefeld is made doubtful. In the cultivation of *Marasmius* the author used sterilized olive leaves and obtained pure spores by allowing basidiospores to fall in small glass plates filled with sterile water placed beneath the pileus. Suggests possible application of pure artificial cultures to the industry. (D. G. F.)

881. DEARNESS, J. **Poisoning from eating fungi.** <Farmers' Advocate, vol. [illegible] London, Ont., p. 216, fig. 1.

Gives full account of a fatal case of poisoning attributed to eating of *Helvella* [illegible] (Fries). This species has hitherto been considered edible by Berkeley, Gilbert, [illegible] and Julius Parmer. While author thinks it is not clearly proven that the species is poison[illegible]ous he decides it is unfit for use. (D. G. F.)

882. DEVAUX, HENRI. **Étude expérimentale sur l'aération des tissus massifs: Introduction à l'étude du mécanisme des échanges gazeux chez les plantes aériennes.** <Ann. Sci. Nat. Bot., sér., VII, vol. XIV, Paris, 1891, pp. 297-395, fig. 5.

In course of his extended investigations the author examined the common edible [illegible] *Psalliota campestris*. There is easy communication through the internal tissues [illegible] exterior is only slightly porous. The composition of the internal gas differed only [illegible] from the atmosphere, but varied somewhat from time to time. The proportion of [illegible] may fall below 16 in 100. Seven analyses are given, and analogous results are said to [illegible] been obtained with another subject. The examination was made before the pileus was developed. (E. F. S.)

883. [EDITORIAL.] **A novel mode of using disease germs.** <Insect Life, vol. IV, Washington, Nov., 1891, p. 152.

Gives abstract of a circular of a French firm advertising for sale culture tubes for the destruction of the white grub. States methods recommended. (J. F. J.)

884. [EDITORIAL.] **Work in Algeria with a fungous disease of the locust.** <Insect Life, vol. IV, Washington, Nov., 1891, pp. 151-152.

Abstract of a paper by Künckel and Langlois on a disease caused by *Lachnidium acridiorum* n. sp. The experiments are not encouraging. (J. F. J.)

885. EYCLESHEIMER, A. C. **Club root in the United States.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 79-80, pl. XV, XVI, figs. 2.

Discusses the distribution and general characters of the disease. This is followed by a detailed statement of the effect of the disease on the tissues of various plants, particularly cabbages and turnips. There is no known cure after the disease is established, but preventive measures may be effectual. Of all means tried lime seems to be the best. Sterilization of the soil of the hotbed is also recommended. A short bibliography is given at the end of the paper. (J. F. J.)

886. FORBES, S. A. **On a bacterial insect disease.** <Amer. Month. Micros. Jour., vol. XII, Washington, Nov., 1891, pp. 246-249.

Describes disease affecting chinch bugs, caused by *Micrococcus insectorum* Burr. No success has been met with in attempting to inoculate insects with the disease, because all examples examined were infected with the *Micrococcus* in question. (J. F. J.)

887. FRIES, ROB. **Om svampfloran i våra växthus.** <Bot. Notiser, Lund, 1891, pp. 145-157.

Fungi arranged in three groups: (1) Species which, under natural circumstances, are living in open air, but which accidentally may also occur in hothouses, often with a somewhat changed habit and appearance. (2) Species which *par préférence* are inhabitants of hothouses, and which do not occur in other places at least not in Sweden. (3) Species which have been accidentally introduced from southern lands. The second group includes several interesting species, most of which occur in great abundance, such as *Lepiota cepæstipes*, *Agaricus echinatus*, *A. volvaceus*, *A. parvulus*, *A. confertus*, *Polyporus cryptarum*, *Coprinus dilectus*, *Discina vaporaria*, and *Hydnangium carneum*. But very few species are mentioned as representing the 3d group e. g. *Hiatula benzonii*, *Agaricus geoglerius*, *Lachnea testudinella*. (Theo. Holm.)

888. GALLOWAY, B. T. **Observations on the life history of Uncinula spiralis.** <Proc. Am. Asso. Adv. Sci., vol. XXXIX, July, 1891, Salem, Mass., p. 333, 3 lines.

Abstract (see No. 132). (J. F. J.)

889. GALLOWAY, T. W. **Notes on the fungus causing damping off and other allied forms.** <Trans. Mass. Hort. Soc., Part 1, Boston, 1891, pp. 10, pl. 2.

Records interesting observations on *Pythium debaryanum* and *Saprolegnia monoica* made in the cryptogamic laboratory, Harvard University. (B. T. G.)

890. GIARD, A. **Sur le champignon parasite des criquets pèlerins.** <Compt. rend. Acad. d. Sc., Paris, Dec. 7, 1891, pp. 813-816.

The author says that Prof. H. Trabut has found that *Lachnidium acridiorum* Giard is identical with the fungus found in different parts of Algeria on the same host. Older cultures of the fungus furnish evidence as to its systematic position. On the insects themselves it presented two different forms, designated *Cladosporium* and *Fusarium*, or *Fusisporium*. In young cultures the latter predominates. When the cultures become old, chlamydospores make their appearance. From this time parts of the fungus pass through stages closely resembling the genera *Sarcinella*, *Stemphylium*, *Macrosporium*, and *Mystrosporium*. *Cladosporium herbarum* also passes through similar stages, and it is probable that the two fungi are closely related. It is also likely that the genera represented in the transformations are really not independent genera, but stages in the development of some Ascomycete. The *Lachnidium* closely resembles the *Fusarium* on violet leaves and chestnut trees. (E. A. S.)

891\. GOSIO, B. **Action of microphytes on solid compounds of arsenic; a recapitulation.** <Science, vol. XIX, New York, Feb. 19, 1892, pp. 104–106.

A paper on the poisonous products derived from wall papers containing arsenic. Gives methods used to ascertain whether the arsenical vapors are due to the presence of parasitic molds (*Mucorini.*) By means of pure cultures of *Penicillium glaucum*, *Aspergillus glaucus*, and *Mucor mucedo*, it was found that the two latter, and more especially the last, gave rise to arsenical gas when grown in arseniated culture media. Experiments led to the conclusions: (1) that the Mucor grew vigorously in media containing considerable quantities of arsenic; (2) that many solid compounds of arsenic give off gases through the activity of the fungus which vegetates in contact with them; (3) this evolution of gas is constant and lasting in case of oxygen compounds of arsenic, including arsenite of copper; (4) in certain conditions of humidity, temperature, and light, arsenical gases are given off from hangings colored with Scheele's and Schweinfurth's green, through the vegetation of the *Mucor*, and there is danger in breathing these exhalations. (J. F. J.)

892\. H., * * * G. **Suspicious fungi.** <Cult. and Count. Gent., vol. LVII, Albany, N. Y., Mar. 10, 1892, p. 187, ½ col.

Queries whether corn smut has any poisonous effect on cattle or whether two or three months in the silo would tend to destroy its vitality. Notes the disappearance of ergot from rye fields in recent years. (J. F. J.)

893\. HALSTED, B. D. **Autumn leaves disperse their molds.** <Am. Agric., vol. L, New York, Dec., 1891, p. 700, ½ col.

Refers to the distribution of fungous spores over wide areas by means of the wind. (J. F. J.) (See Kansas Weekly Capital, Topeka, May 5, 1892.)

894\. KIENITZ-GERLOFF, F. **Die Protoplasmaverbindungen zwischen benachbarten Gewebeselementen in der Pflanze.** <Bot. Zeit., Jahrg. 49, Leipzig, Jan. 2, 9, 16, 23, 30, 1891, pp. 1–10, 17–26, 33–46, 49–60, 65–74, pl. 2.

The paper deals mostly with the continuity of protoplasm in higher plants, but on p. 66 the implication is made that parasitic fungi obtain their nourishment from the host cell by secreting a diastase-like ferment. On p. 67 the author proposes the theory that the fungus hyphæ in lichens obtain their nourishment from the algæ cells by secreting an enzyme. Thinks protoplasmic connections may be found between the neighboring cells of fungi when not all the cells are equally engaged in absorbing nourishment. Further states that their presence is rendered more probable from the fact that pits have been observed in the hyphæ of *Hymenomycetes*. (W. T. S.)

895\. LAGERHEIM, G. DE. **The relationship of Puccinia and Phragmidium.** <Journ. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 111–113.

Gives differences usually stated as occurring between the two genera, especially in the teleutospores and uredospores, examining various species. Concludes there are points of resemblance between numerous species of the two genera. (J. F. J.)

896\. MOULT, M. LE. **Le parasite du hanneton.** <Compt. rend. Acad. d. sc., vol. CXIII, Paris, Aug. 3, 1891, pp. 272–274.

The author states that he has prepared cultures of the parasite on a large scale and urges the necessity of combating the beetle by infecting the soil before the transformation of the larva occurs. Has found spores produced both on the external mycelium and within the body of the larva, filling the latter with a whitish powder. Culture tubes infected with both kinds of spores and with parts of the body of a mummified larva have given identical results, the fungus produced having the same characters as that on the worm. (E. A. S.)

897\. OSBORN, HERBERT. **On the use of contagious diseases in contending with injurious insects.** <Insect Life, vol. III, Washington, Nov. 1, 1890, pp. 141–145.

Refers in a general way to the various diseases of insects, some of which are caused by fungi, and to the difficulties in their study. Gives an account of an attempt to introduce a disease of cabbage worms caused by a species of *Micrococcus*. Believes the disease may be transferred from place to place, but that it spreads very slowly and the final results are uncertain. (J. F. J.)

898\. PEARSON, A. W. **Constitutional health of plants.** <Gard. and Forest, vol. V, New York, Mar. 9, 1892, p. 118, 1½ col.

Notes that at times the spores causing black rot destroy certain varieties of grapes and not others. The Ives is at times exempt when the Concord is destroyed. Queries whether antidotes for certain diseases might not be supplied plants through their absorptive systems. Healthy plants are better able to resist attacks of disease and when attacked are more likely to recover. An instance of this is given from the potato. (J. F. J.)

899\. PEARSON, A. W. **The constitutional health of plants.** <Gard. and Forest, vol. V, New York, Mar. 16, 1892, pp. 130–131, 1½ col.

Gives results of experiments with nitrate of soda as a preventive of strawberry leaf-blight. Considers that the immunity from disease was due to vigorous growth and the stimulating effect of nitrate. Pruning pear trees by stimulating growth prevented attacks of leaf-blight and cracking due to *Entomosporium maculatum*. (J. F. J.)

900\. RILEY, C. V. **Applied entomology in the United States.** <Am. Agric., vol. LI, New York, Jan., 1892, pp. 38–40.

Refers incidentally to use of fungous germs for destruction of insects. (J. F. J.)

901. ROSEN, F. **Bemerkungen über die Bedeutung der Heterogamie für die Bildung u. Erhaltung der Arten im Anschluss an zwei Arbeiten von W. Burck.** <Bot. Zeit., 49 Jahrg., Leipzig, Mär. 27., 1891, pp. 201–211, April 3, 1891, pp. 217–226.

Author considers the following works by W. Burck, "Ueber Kleistogamie im weitern Sinne und das Knight-Darwin'sche Gesetz" (Annales du Jardin Botanique de Buitenzorg, vol. VII, pp. 122–164, taf. 4) and "Eenige bedenkingen tegen de theorie van Weismann aangaande de beteekenis der sexueele voortplanting in verband met de wet van Knight-Darwin" (Natuurkundig Tijdschrift voor Nederlandsch Indië, Diel XLIX (achtste serie, x, pp. 501–544, pl. I). Discusses the importance of cross-fertilization in plants and on Weismann's theory that variability depends on sexual reproduction. Most of the article discusses phanerogams, but on p. 225 he adduces the alga-like fungi as an example of plants which have sexual propagation and *Basidiomycetes* as example of a variable group of species, which propagate exclusively by asexual means. Mentions that these fungi are chemically and histologically much differentiated. Mentions Uredineæ as progenitors of Basidiomycetes. Opposes the Knight-Darwin law and Weismann's theory. (W. T. S.)

902. SNOW, F. H. **Experiments for the destruction of chinch bugs in the field by the artificial introduction of contagious diseases.** <Insect Life, vol. III, Washington, Mar., 1891, pp. 279–284.

Gives details of experiments made in 1889 and 1890 to spread an infectious disease. Three diseases were noticed, one caused by *Entomophthora* or *Empusa*, one by a *Micrococcus*, and the third by a species of *Isaria* or *Trichoderma*. Numerous letters are quoted giving details of success of the work. (J. F. J.)

903. STOLLER, JAS. H. **Studies in plant biology. II.—The green mold.** <Pop. Science News, vol. XXV, Boston, Mar., 1891, pp. 33–34, 2 cols.

Describes briefly in popular language the biology of *Penicillium glaucum*. (D. G. F.)

904. STRATON, C. R. **The value of attractive characters to fungi.** <Science Gossip, No. 314, London, Feb., 1891, pp. 44–45.

Quotation of an article in "Nature," noticing the colors and odors of fungi, and advancing the idea that these are characters for attracting insects and animals to aid in the multiplication of the species. Says it is necessary for spores of *Agaricus campestris* to pass through the bodies of animals before they will germinate and produce mycelial threads. Believes this to be the case with other species also. (J. F. J.)

905. VAN BREDA DE HAAN, J. **Les Expériences de M. Beyerinck sur les Bactéries lumineuses et leur nutrition.** <Rev. géné. sci. pure et appli., 2e ann., Paris, Feb. 15, 1891, pp. 81–82.

Paper based partly on memoirs in *Archives néerlandaises des sciences exactes et naturelles*, tome XXIII, and partly on unpublished data furnished by the author. Six species of Photobacterium are distinguished, *Ph. phosphorescens*, *indicum*, *luminosum*, *balticum*, *fischeri*, and *pflugeri*. The first renders fish phosphorescent, the second is found in the waters of the Indian Ocean, the third on the coasts of Holland, and the others in the Baltic Sea. Beyerinck's culture methods are described, and especially a new method called auxanographic, whereby he is able to study the exact effect of nutrient substances simply or in combination. The phosphorescence can be produced or eliminated at will without destruction of the organisms, and is believed to be an accidental consequence of internal chemical processes. Different forms can be separated by their behavior toward diastases. Recently these photobacteria have been used to show that the Chamberland filter is germ-proof. (E. F. S.)

906. VAN TIEGHEM, M. D. **Prix Montagne (Commissaires: MM. Duchartre, Trécul, Chatin, Bornet; Van Tieghem, rapporteur).** <Compt. rend. Acad. d. sc., vol. CXIII, Paris, Dec. 21, 1891, pp. 920–922.

Notes the granting of this academic prize to Henri Jumelle for a manuscript memoir entitled, *Recherches physiologiques sur les Lichens*. This investigation was carried on in the laboratory of vegetable biology instituted by the faculty of sciences of Paris in the forest of Fontainebleau. M. J. devoted himself especially to the study of the exchange of gases taking place between lichens and the air under varying degrees of light, humidity, and heat. In obscurity both components of the lichen respire, and the respiratory quotient $\frac{CO_2}{O}$ is always less than unity, about 0.8 oxygen is fixed. In light, the assimilation of carbon, exclusively through the chlorophyll of the alga, predominates over respiration, although the latter continues in both alga and fungus. This predominance varies greatly according to the species and is less noticeable in proportion as the alga occupies less space. In fruticulose and foliaceous lichens it is strong and very noticeable even in diffused light. In crustaceous lichens it is feeble and only manifest in the sun. In all cases the quotient of assimilation $\frac{O}{CO_2}$ is greater than one and may rise to 1.5, 1.6, or even 1.8, a part of the liberated oxygen is therefore borrowed from some other source than the carbon dioxide of the air. Fruticulose and foliaceous lichens contain relatively little water, at most only four times their dry weight, and can not lose this without injury. Gelatinous lichens contain much water, even twenty-four times their dry weight, and can lose it all without injury. Moistened after complete drying they again take up the normal exchange of gases. Lichens bear great variations of temperature without injury. They are unchanged after three days at 45° C., after fifteen hours at 50°, after five hours at 60°. At these temperatures their respiration continues normal, but assimilation ceases after one day at 45°, three hours at 50°, and thirty minutes at 60°. Elevated temperatures therefore suppress the assimilation of carbon without diminishing the respiration—*i. e.*, change the alga without affecting the fungus. Lichens also resist very low temperatures, even below −40°. At −10° respiration is very feeble, at −20° it ceases entirely. On the contrary, the assimilation of carbon not only continues at

these temperatures, but also at much lower ones, even —40°, when, by the freezing of a part of its water of constitution, the lichen has taken the consistency of a block of ice. Low temperatures therefore stop respiration while permitting the assimilation of carbon—*i. e.*, they affect the fungus and not the alga. By reason of the double constitution of lichens these two sorts of gaseous exchange which go on simultaneously in green plants in light can be separated by the action of heat, respiration only, carried on by the fungus, persisting at high temperatures and assimilation only, carried on by the alga, persisting at low temperatures. (E. F. S.)

907. WEBSTER, F. M. **A podurid which destroys the red rust of wheat.** <Insect Life, vol. II, Washington, Jan.-Feb., 1890, pp. 259-260.

Records a species of Neuropter (*Smynthurus*) feeding on uredospores of wheat rust (*Puccinia rubigo-vera*). While the spores eaten are destroyed, the hairs on the body of the insects serve to convey other spores from one plant to another and thus aid in distributing it. (J. F. J.)

See also Nos. 661, 721, 724, 732, 760, 769, 854, 933, and 939.)

F.—MORPHOLOGY AND CLASSIFICATION OF FUNGI.

I.—GENERAL WORKS.

908. BAILEY, F. M. **Botany: Contributions to the Queensland flora.** <Dept. of Agri. Queensland, Bull. No. 9, Brisbane, May, 1891, p. 32.

Gives description of *Glœosporium pestiferum* Cke. & Mass., as occurring in the colony. (J. F. J.)

909. BAILEY, F. M. **Contributions to the Queensland flora.** <Dept. Agric. of Queensland, Bull. No. 13, Brisbane, Dec., 1891, pp. 39, pl. 6.

Under fungi (pp. 36-38) gives list of species found with descriptive notes. No new species. (J. F. J.)

910. BORNET, M. **Prix Desmazières (Commissaires: MM. Duchartre, Van Tieghem, Chatin. Trécul; Bornet, rapporteur).** <Compt. rend. Acad. d. sci., vol. CXIII, Paris, Dec. 21, 1891, pp. 918-920.

Notes the conferring of this Academic prize on A. N. Berlese for meritorious work in Mycology, especially for three important publications. (1) A monograph of the genera *Pleospora*, *Clathrospora*, and *Pyrenophora*, forming a volume of 260 pages, accompanied by 12 colored plates, representing 111 species; (2) *Icones Fungorum ad usum Sylloges Saccardianæ accomodatæ*, of which great enterprise two parts illustrating Pyrenomycetes have been issued; (3) *Fungi moricolæ*, a volume containing 200 pages and 71 colored plates designed and lithographed by the author, and in which he has doubled the number of fungi known previously to occur on the mulberry, and brought out various other interesting facts, *e. g.*, that the fungous flora of the mulberry is quite different from that of the olive, but related to that of the elm and *Brousonetia*, and that certain groups of fungi are wholly wanting, notably the *Hypodermei*, wanting also on the orange. (E. F. S.)

911. CHATIN, M. **Prix Thore (Commissaires: MM. Duchartre, Blanchard, Van Tieghem, Bornet; Chatin, rapporteur).** <Comp. rend. Acad. des sc., vol. CXIII, Paris, Dec. 21, 1891, p. 923.

Note on the conferring of this academic prize on MM. J. Constantin and L. Dufour for their *Nouvelle Flore des Champignons*. This flora, modeled on M. Gaston Bonnier's phænogamic flora, contains 3,812 figures, and has for its object the easy determination of all the fungi growing in France as well as of most European species. (E. F. S.)

912. COLENSO, W. **An enumeration of fungi recently discovered in New Zealand.** <Trans. & Proc. New Zealand Inst. for 1890, vol. XXIII, Wellington, May, 1891, pp. 391-398.

Gives list of species collected in New Zealand as identified by M. C. Cooke in London, Eng. (J. F. J.)

913. ELLIS, J. B., and EVERHART, B. M. **New species of fungi.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 130-135.

The following new species are described: *Puccinia suksdorfii* on leaves of *Troximon glaucum*: *P. agropyri* on leaves of *Agropyrum glaucum; Stictis compressa* on dead limbs of *Carpinus americana; Tryblidiella pygmæa*, on weather-beaten wood; *Valsaria hypoxyloides* on shrub or tree from Paraguay; *Phyllosticta gelsemii* on leaves of *Gelsemium sempervirens* (cult.); *P. rhododendri* on leaves of *Rhododendron catawbiense; Sphæropsis albescens* on dead limbs of *Negundo aceroides; Stagonospora spinaciæ* on spinach; *Septoria elymi* on leaves of *Elymus canadensis; S. jackmani*, on leaves of *Clematis jackmani; S. saccharina* on leaves of seedling *Acer saccharinum; S. drummondii*, on leaves of *Phlox drummondii; Hendersonia geographica*, on fal[l]en and decaying chestnut leaves; *Glœosporium catalpæ* on leaves of *Catalpa bignonioides; G. decolorans* on leaves of *Acer rubrum; Melanconium magnoliæ* on dead trunks of *Magnolia glauca; Pestalozzia lateripes* on dead legumes of *Cassia chamæcrista; Scolecotrichum caricæ* on leaves of *Carica papaya: Macrosporium tabacinum* on leaves of cultivated tobacco; *M. longipes* on the same; *Brachysporium canadense* parasitic on *Valsa ambiens*? ; and *Clasterosporium populi* on leaves of *Populus tremuloides*, and *P. grandidentata*. (J. F. J.)

914. ELLIS, J. B., & HALSTED, B. D. **New fungi.** <Jour. Mycol., vol. VI, Washington, May, 1890, pp. 33–35.

Describe the following new species: *Phyllosticta molluginis* on *Mollugo verticillata*; *Septoria rudbeckiæ* on *Rudbeckia laciniata* and *R. hirta*; *Glœosporium cladosporioides* on *Hy[illegible] mutilum*; *Cylindrosporium iridis* on *Iris versicolor*; *Zygodesmus pyrolæ* on *Pyrola ro[illegible]lia*; *Cercospora lysimachiæ* on *Lysimachia stricta*; *C. cleomis* on *Cleome pungens*; and [illegible]letotrichum spinaciæ* on spinach. (J. F. J.)

915. ELLIS, J. B., & GALLOWAY, B. T. **New species of fungi.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 31–33.

Describe the following new species: *Æcidium crepidicolum* on *Crepis acuminata*; *Ustilago (Sorosporium?) brunkii* on *Andropogon argenteus*; *Sorosporium ellisii* Winter var. *provincialis* on *Andropogon provincialis*; *S. everhartii* on *Andropogon virginicus*; [illegible]*phæria denudata* on dead oak limbs; *Ophionectria everhartii* on old *Diatrype* [illegible] decaying bark of oak limbs; *Glœosporium paludosum* on *Peltandra virginica*; *Ce[illegible] brunkii* on cultivated Geranium; *Dendrodochium subeffusum* on lichen thallus, and *Se[illegible]ces andersoni* on decaying *Pinus ponderosa*. (J. F. J.)

916. ELLIS, J. B., & LANGLOIS, A. B. **New species of Louisiana fungi.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 35–37.

The following species are described: *Oidium obductum* on young *Quercus*; *Ovularia [illegible]cluræ* on *Maclura aurantiaca*; *Dactylaria mucronulata* on decaying hickory wood; *C[illegible]porium mycophilum* parasite on *Polyporus pergamenus* and *Lentinus ursinus*; *Horm[illegible] divaricatum* on rotten wood; *Cercospora alternantheræ* on *Alternanthera achy[illegible]*; [illegible] *thaliæ* on *Thalia dealbata*; *Macrosporium carotæ* on *Daucus carota*; *Graphium squa[illegible]* on *Sambucus*; *Sphærdium lacteum* on decaying herbaceous stems; *Phyllosticta vir[illegible]* on *Quercus virens*; *Vermicularia discoidea* on *Panicum proliferum*; *Haplosporella [illegible]* on *Andropogon muricatus*; *Diplodia bambusæ* on dead *Bambusa*; *D. cucurbitaceæ* on dead pumpkin vines; *Botryodiplodia varians* on dead *Lagerstrœmia*; *Hendersonia tini* on *Viburnum tinus*, and *Prosthemiella hysterioides* on decorticated wood of *Salix nigra*. (J. F. J.)

917. ELLIS, J. B., & TRACY, S. M. **A few new fungi.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, pp. 76–77.

The following species are described: *Phyllachora stenostoma* on *Panicum brizanth[illegible]*; *Fusarium celtidis* on *Celtis occidentalis*; *Cladosporium velutinum* on *Phalaris canari[illegible]*; *Puccinia apocrypta* on *Asprella hystrix*; *Uredo peridermiospora* on *Spartina glabra*; *U[illegible]sea* on *Nyssa capitata*; *Ustilago buchloës* on *Buchloë dactyloides*; *Cintractia avenæ* on *Ar[illegible] elatior*; *Sorosporium granulosum* on *Stipa viridula*; *Ustilago hilariæ* on *Hilaria jamesii*, and *U. oxalidis* in ovaries of *Oxalis stricta*. (J. F. J.)

918. GARCIDA, MANUEL MARTENES. **Catalogos de la Flora y Fauna del Estado de Oxaca.** <Imprenta del Estado á cargo de Ignacio Candiani, Oxaca, 1891, pp. II, 116.

Gives an alphabetic list of plants on pp. 1–48, arranged by the common name, followed by the scientific name, family, and authority. Some fungi of the genera *Uredo* (*U. maidis* D[illegible]), *Agaricus*, *Boletus*, *Hypophyllum* are given. (W. T. S.)

919. KARSTEN, P. A. **Fragmenta mycologica, XXXII.** <Hedwigia, Bd. XXX, Dresden, Sept. and Oct., 1891, pp. 246–248.

Notes on a number of old species, and descriptions of the following new species and varieties from Finland: *Mycena simillima* on decaying trunks; *Volvaria virgata*, Fr. v. [illegible] "in vaporariis;" *Cortinarius cinnamomeus* (Linn) Fr. v. *fusipes*; *Bjerkandera rosma[illegible]* on cut trunks of *Larix siberica*; *Ephelina aggregata* (Lasch) Karst (*Sphaeria aggregata* Lasch in Rab. Herb. myc., II, 541) *Zignoella borealla* on disks of *Valsa borealis*; *Monilia obdu[illegible]* bodies of alcoholic specimens of *Colubrus natrix*; *Fusariella cladosporioides* on living leaves of *Myrtus*; *Botrytis virella*, Fr. var. *ærugineoglauca* on decaying wood. (W. T. S.)

920. KARSTEN, P. A. **Fragmenta mycologica XXXIII.** <Hedwigia, Bd. XXX, Dresden, Nov. u. Dec. 1891, pp. 298–300.

Notes on old species and descriptions of following new species and varieties from Finland: *Psathyrella longicauda*, among rotten leaves; *Poria labyrinthica*, on decaying pine wood; *Peziza lætissima*, on rotten leaves; *Melanospora macrospora*, on decaying tubers of *Brassica napus* var. *napobrassica*; *Botrytis laxissima*, on decaying substances on damp ground; *Hymenula vulgaris*, Fr. var. *brassicæ*, on decaying tubers of *Brassica napus* var. *napobrassica*; *Symphyosira alba*, on wood in fields. (W. T. S.)

921. KARSTEN, P. A. **Fragmenta mycologica XXXIV.** <Hedwigia, Bd. XXX, Dresden, Nov. u. Dec. 1891, pp. 300–303.

Gives notes on old species and descriptions of the following new species and varieties: *Pistillaria cylindracea*, on petioles of decaying leaves of *Alnus incana*; *P. fulvida*, on de[illegible] leaves of *Cornus sanguinea*; *Discinella* n. g. [Pezizaceæ]; *D. corticalis*, on dead trunks of *L[illegible]cera tartarica*; *Pestalozzia inquinans*, on living leaves of *Camellia*; *Fusicladium [illegible]* on petioles of living leaves of *Liristonia chinensis*; *Cylindrium flexile*, on branches of [illegible] and *Pyrus*; *Hymenula microsporella*, on decaying tubers of *Brassica napus* var. *napobrassica*; *Myropyris guttiformis*, on the interior of decaying bark; *Hormiactis nectriæ*, on *Nectria coccineum*; *Sporotrichum vile*, on *Cladosporium* on stems of *Brassica napus*. (W. T. S.)

922. LAGERHEIM, G. **Observations on new species of fungi from North and South America.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 44–50.

Describes a hollyhock disease caused by a new species of fungus, *Puccinia heterogenea*, a new cotton rust caused by *Uredo gossypii*; a new *Doassansia* on cotton, called *D. gossypii*, and a new *Peronospora* on *Gonolobus* from South Carolina, called *P. gonolobi*. The first three species are from Ecuador. (J. F. J.)

923. LUDWIG, F. **Contributions on the fungal flora of Australia.** <Trans. Roy. Soc. South Australia, vol. XIV, Adelaide, July, 1891, pp. 55–60.

Part I deals with the rusts and smuts (*Uredineæ* and *Ustilagineæ*) giving a list of 45 species. Part II gives a list of the fungous enemies of Eucalyptus and Acacia, 22 in all. Of these, the following are named as new species, the authority given being Saccardo, except for the last. No descriptions are given. *Ceriomyces incomptus. Rhamphoria tenella, Phyllosticta phyllodiorum, Septoria phyllodiorum*, and *Uredo notabilis* Ludw. Part III is on the position of *Clathrus (Ileodictyon) tepperianus* Ludw., noting that it should probably be united with *C. gracilis* and *C. cibarius* under the latter name. (J. F. J.)

924. PLOWRIGHT, C. B., WARD, H. G., and ROBERTSON, J. **List of fungi found at Sterling on 26th and 27th October, 1891.** <Ann. Scot. Nat. Hist., vol. I, Edinburgh, Jan., 1892, pp. 68–69.

A list of species without notes. (J. F. J.)

925. RACIBORSKI, M. **Ueber einige Pilze aus Südrussland.** <Hedwigia, Bd. XXX, Sept. u. Oct. 1891, Dresden, pp. 243–246.

Gives a list of 27 species (1 *Cystopus*, 2 *Ustilago*, 6 *Uromyces*, 7 *Puccinia*, 3 *Gymnosporangium*, 1 *Phragmidium*, 2 *Melampsora*, 3 *Æcidium*, 1 *Rhytisma*, 1 *Pleospora*), with localities and host plants. Gives notes on *Uromyces lævis* Kœrnicke, making Sydow Ured. No. 161 on *Euphorbia gerardiana*, *U. lævis* var. *trachyspora* and Rabenhorst Herb. Myc. No. 299 (pro parte); on *Euphorbia verrucosa* he makes *U. scutellatus* Schrank var. *leptoderma*. Thinks Magnus and Dietel may be mistaken in referring *U. lævis* to *Uredo excavata* DC., which the author thinks more probably identical with *Melampsora euphorbiæ dulcis* Otth. (W. T. S.)

926. RICHON, CH. **Liste alphabétique des principaux genres mycologiques dont les spores, sporidees et conidies sont représentées fortement amplifiées, avec l'indication de leurs dimensions réelles.** <Rev. Mycol., vol. XIII, Toulouse, Oct., 1891, pp. 160–162, pl. CXX–CXXIV.

An alphabetical list of typical species selected to illustrate 287 genera beginning with *Leptosphærites lemoinii*. Each species enumerated is illustrated. (E. A. S.)

927. ROLLAND, L. **Quelques champignons nouveaux du Golfe Juan.** <Bull. Soc. Mycol. France, vol. VII, fasc. 4, Paris, Dec. 31, 1891, pp. 211–213, pl. XIV.

Describes the following: *Calosphæria puniceæ, Amphisphæria cocos, Gibberella trichostomi, Mollisia ericæ, Glæosporium suberis, Stictis opuntiæ.* (E. A. S.)

928. ROUMEGUERE, C. **Fungi exsiccati precipue Gallici, LXe centurie.** <Rev. Mycol., vol. XIV, Toulouse, Jan. 1, 1892, pp. 1–11.

List of 100 fungi and their hosts, containing the following new species: *Phacidium jacobææ* Faut. and Roum., on *Senecio jacobæa; Calloria medicaginis* Faut. and Roum., on *Medicago sativa* form *meliloti* on *Melilotus officinalis; Saprolegnia quisquiliarum; Didymosphæria ammophilæ* Faut. and Roum., on *Ammophila arenaria; Læstadia mespili*, on *Mespilus germanica; Venturia furcata* on *Sabina; Leptosphæria viticola* Faut. and Roum., on *Vitis vinifera; L. phaseoli* Faut. and Roum., on *Phaseolus nanus; L. melanommiodes*, on *Phaseolus nanus; L. sambuci*, on *Sambucus nigra; Hendersonia peregrina*, on *Phœnix dactylifera; H. calospora*, form *unioeæ*, on *Uniola latifolia*, form *poæsudeticæ*, on *Poa sudetica*, form *ammophilæ* on *Ammophila arundinacea; H. culmifraga*, on *Uniola latifolia; Dendrophoma didyma* Faut and Roum., on *Quercus pedunculatus; Rhabdospora campanulæ*, on *Campanula trachelium; Ramularia picridis* Faut and Roum., on *Picris hieracioides; R. beccabunga*, on *Veronica beccabunga; Balacotricha lignorum* Faut and Roum., on rotten oak plank. (E. A. S.)

929. ROUMEGUERE, C. **Fungi Gallici exsiccati.** <Rev. Mycol., vol. XIII, Toulouse, Oct., 1891, pp. 163–173.

A list of 100 fungi, containing also names of hosts, synonyms and localities. Several new species are described: *Thyridium betulæ*, on *Betula alba; Sphærella acerna*, on *Acer campestre; S. nigrificata* Faut. & Roum., on *Agrostis stolonifera; S. juniperi* Faut. and Roum., on *Juniperus communis; S. maculata*, on *Prunus mahaleb; Leptosphæria rumicis*, on *Rumex patientia; Lophodermium sabinæ*, on *Juniperus sabina; Coniothyrium phalaridis* Faut. and Roum., on *Phalaris arundinacea; Phoma solani-lycopersici* Faut. and Roum., on *Solanum lycopersicum; P. populi-tremulæ*, on *Populus tremula; Cytospora viburni* Faut. and Roum., on *Viburnum lantana; Rhabdospora aconiti*, on *Aconitum napellus; Diplodia sambucicola*, on *Sambucus nigra; Pestalozzia sabinæ* on *Juniperus sabina; Myxosporium sabinæ* Faut. and Roum., on *Juniperus sabina; Coryneum avellanæ* on *Corylus avellana; Trinacrium variabile* on *Solanum lycopersicum; Dendrodochium lignorum*, on oak bark; *Fusarium discoideum* Faut. and Roum., on *Sambucus nigra.* (E. A. S.)

930. SACCARDO, P. A. **Rathschläge für die Phytographen, insbesondere die Kryptogamisten.** <Hedwigia, Bd. XXX, Dresden, Jan. u. Feb. 1891, pp. 56–59.

Recommends the following rules to phytographers: (1) Give concise diagnoses of a new species, not extended accounts of its morphology and biology without any clear statement of its distinguishing characters: (2) Diagnoses should be in clear and concise form, giving the important and distinctive characters; remarks on details should be given after the diagnosis, and it is necessary to indicate the relationships of the species; (3) The name of the original author of a species that has been removed to another genus should be given in parenthesis as the author of the species, and outside the parenthesis should be placed the name of the person who transferred the species to another genus; (4) The scientific name of the host organism should always be given in describing parasitic species; (5) The metric system should be used in giving the size of organs; for microscopic measurements, micromillimeters or mikra (μ) are to be employed instead of fractions; (6) For expressing concisely the dimensions of microscopic organs the length should first be given, then the width, the numbers being connected by the sign $\asymp$ and the sign μ omitted. The sign $\asymp$ (which the author proposed in 1872) has the advantage over the signs =, :, × of not having a different and definite

meaning in mathematics; (7) All names of all groups of plants should be in the fem[illegible] gender—Hymenomyceteæ, not Hymenomycetes; (8) A distinct nomenclature bas[illegible] normal examples of colors should be followed; (9) It would be useful in case of fun[illegible] only the following names for fruits and spores, since these names are already in u[illegible] mycologists; *Hymenomyceteæ*, pileus, basidia, sterigmata, sporæ, cystidia; *Gaster*[illegible] and *Myxomyceteæ*, peridium, gleba, capillitium, flocci, sporæ; *Uredineæ*, sorus, ured[illegible] teleutosporæ, mesosporæ, pseudoperidium, æcidiosporæ, paraphyses; *Phycomyceteæ*, [illegible] oösporæ, antheridia, spermatia, zygosporæ, azygosporæ, zoösporangia, zoösporæ; *Per*[illegible] *cetaceæ* and *Phymatosphæriaceæ*, stroma, perithecium, loculus, ascus, sporidi[illegible], parap[illegible] *Discomyceteæ*, and *Tuberoideæ* ascoma, gleba, ascus, sporidia, paraphyses; *Schiz*[illegible] filamenta, baculi, cocci, endosporæ, anthrosporæ; *Sphæropsidæ*, [sic] perithecium [illegible] conidia (but not *gonidia*, a term to be restricted to lichens); *Hyphomyceteæ*, c[illegible] sporodochium, hyphæ, sporæ. The promycelium originating from the germinati[illegible] generally bears sporidiola. (W. T. S.) (See No. 565; also Bot. Gaz., vol. XVI, May, 18[illegible] pp. 153–155.)

921. SPEGAZZINI, CAROLO. **Fungi guaranitici nonnulli novi v. critici.** <Revista Arg[illegible]tina Hist. Nat., vol. 1, Buenos Aires, Dec. 1, 1891, pp. 398–432.

Gives notes on many species and descriptions of the following new ones: *Æcidium* [illegible] *vulinum* on *Convolvulaceæ*; *Æ. talini* on *Talinum patentis*; *Æ. xanthoxylinum* on [illegible] *lum*; *Æ. calyculatum* on *Hamelia* sp.; *Æ. ochraceum* on *Tabernæmontanum*; *Æ.* [illegible] *dinum* on *Morreniæ*; *Tuberculina talini* on *Talinum patentis*; *Meliola obesula* on [illegible] *M. læripoda* on *Aspidosperma quebrachii*; *M. harioti* on *Bignoniaceæ*(?) and *Legumin*[illegible] *M. sapindacearum* on *Sapindaceæ*; *Dimerosporium? ovoideum* on *Gramineæ*; *D. super*[illegible] *Croton* sp.; *Broomella phyllocharis*; *Phyllachora læviuscula* on *Rubiaceæ*; *P. quebrach*[illegible] *Aspidosperma quebrachii*; *P. subtropica*; *P. gentilis* on *Eugenia*; *P. acutispora* on *Gra*[illegible] *Microthyrium acervatum* on *Rutaceæ*; *Seynesia? nebulosa* on *Myrsine*; *Asterina sphær*[illegible] *Trichothyrium fimbriatum*; *Micropeltis vagabunda* on *Aspidosperma quebrachii*; *M.*(?) [illegible] *Lembosia nobilis*; *Peziza edulis* on earth; *Phyllosticta eryngii* on *Eryngium pandan*[illegible] *Chætophoma chlorospora* on *Randia*; *Rabenhorstia dissoidea* on decaying *Carica*; *Pe*[illegible] *patella* (n. gen.); *P. lecanidion* on *Citrus aurantiacus*; *Septoria eugenicola* on *Eugenia*; *S. eugeniarum* on *Eugenia*; *Leptothyrium magnum* on *Nectandra*; *L. ampullulip*[illegible] *Lauraceæ*; *Asterostomella cristata* on *Rutaceæ*; *A. subreticulata* on *Cestrus pubescens*; *A.* [illegible] *gulata* on *Euphorbiaceæ*; *Melasmia pulchella* on *Eugenia*; *Melophia macrospora* on *E*[illegible] *M. superba* on *Myrtus guaviyus*; *Glœosporium tabernæmontanæ* on *Tabernæmontanum*; [illegible] *conium? bambusinum* on *Bambusaceæ*; *Cylindrosporium olyria* on *Olyria*; *Oospora ver*[illegible] *color*; *Heterosporium chloridis* on *Chloris*; *Sarcinella? solanicola* on *Solanaceæ*; and *Ast*[illegible] *tium? cronartioides* on *Bignoniaceæ*. (J. F. J.)

922. TOLF, ROBERT. **Mykologiska notiser från Småland I. Uredineer, Peronosporeer, Perisporiacéer.** <Botan. Notiser, Lund, 1891, pp. 211–220.

The author gives a list of fungi collected in Småland (Sweden). About 100 species of *Uredineæ*, 30 *Peronosporaceæ*, and 19 species of *Perisporiaceæ* are enumerated. No new species are recorded. (Theo. Holm.)

II.—CHYTRIDIACEÆ.

923. DANGEARD, P. A. **Mémoire sur quelques maladies des algues et des animaux, phénomenès de parasitisme.** <Le Botaniste, 2e sér., Paris, 12 Août 1891, pp. 232–264, pl. 4.

The author divides the memoir into three chapters, the first relating to parasites found upon marine algæ growing in the maritime laboratory of *Luc-sur-Mer*, the second to diseases found in the cultures of fresh-water algæ, and the third to a few diseases of lower animals. In Chapter I are described, with figures, *Ciliophrys marina* n. s. (saprophytic) and *Aphel*[illegible] *lacerans* De Bruyne (parasitic) on *Ulva lactuca*, and *Olpidium aggregatum* n. s. on *Clad*[illegible] *marin*, notable as being a member of the family *Chytridiaceæ* on a marine alga. Chapter II treats of the monadine, *Endomonadina concentrica* nov. gen., nov. sp., producing an epidemic disease of *Palmella hyalina* (?); of *Minutularia elliptica*, n. s. on alga undetermined, which together with the *Chytridium destruens* Nowak, placed by Dangeard in *Minutularia* form a small genus by themselves on *Draparnaldia glomerata*, causing a true epidemic *Chytridium mamillatum* Braun. on *Conferva bombycina*; *Chytridium assymetricum*, n. sp. [illegible] *Zygnema*; *C. sphærocarpum* (*Rhizidium*, Zoph) on *Zygogonium*; *Micromyces* [illegible] Dangeard, on divers algæ, Oscillarias and Nitellas; *Gymnophrydium hyalinum*, n. g., n. sp. on *Euglena*; *Nuclearia minima*, n. sp. *N. delicatula* Cienk, and *Ptatoum* (*Clamydophrys*) *stercoreum*, Cienk, on *Closterium*; *Antlea Closterii*, n. g., n. s., *Nuclearia simplex* Cienk. and *Bacillus closterii*, n. sp., are also described. Chapter III describes the following diseases; *Harposporium anguillulæ* Lohde, on Anguillæ, and a bacterial disease of *Ophry*[illegible] *versatile*, which suggests to the author that the struggle between the nucleus of the cell attacked and the bacteria is prolonged by the former's peculiar long ribbon shape. Throws out suggestion that the nuclei of the cells of fungi and higher plants, as well as of animal cells, are principally storehouses of food for the surrounding protoplasm, and the protoplasm dies only when the stock of nutriment in the nucleus is exhausted. (D. G. F.)

(See also, Nos. 736 and 832.)

III.—OOMYCETES.

934. SWINGLE, W. T. **Some Peronosporaceæ in the herbarium of the Division of Vegetable Pathology.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 109–130.

Gives notes, with mention of localities, on 46 species of *Peronosporaceæ*. *Albugo* Persoon = *Cystopus* Lév. Tables of measurements are given of conidia of *Plasmopara* [illegible] *lobi*, and of oöspores of *Peronospora cynoglossi*, and *P. echinospermi*. *P. echinospermi* Swingle = *P. cynoglossi* var. (?) *echinospermi*. (J. F. J.)

935. WAITE, M. B. **Description of two new species of Peronospora.** <Jour. Mycol., vol. VII, No. 2, Washington, Mar. 10, 1892, pp. 105–109, pl. XVII.

Describes two new species under names of *Peronospora celtidis* on *Celtis occidentalis*, and *P. hydrophylli* on *Hydrophyllum virginicum*. (J. F. J.)

(See also, Nos. 695, 716, 724, and 889.

IV.—ZYGOMYCETES.

936. MAYER, W. **Die Hefereinzucht und ihre Bedeutung für die Gährungs-Industrie.** <Der Technicker. Internat. Fachbl. teckn. Wissensch., Jahr. XIV, No. 4, New York, Feb., 1892, pl. 1, figs. 3.

A review of recent progress in the matter of using pure yeast. Mentions and figures *Mucor mucedo*. Nothing original is given on fungi. (W. T. S.)

(See also, No. 736.)

V.—BASIDIOMYCETES.

937. A., * * * T. E. **Gigantic puffball.** <Science Gossip, No. 324, London, Dec., 1891, p. 281, ⅛ col.

Notes a specimen of *Lycoperdon boviata* [sic] found in Suffolk, 4 feet in circumference. (J. F. J.)

938. [Anon.] **An edible fungus of New Zealand.** <New Zea. Journ. Sci., new ser., vol. I, Dunedin, Mar., 1891, pp. 55–58.

Refers to *Hirneola polytricha* Mont. and quotes from Colenso in Trans. of Penzance Nat. Hist. and Antiq. Soc., 1884–'85, a description of same. In 12 years 1,850 tons 11 cwt., valued at £79,752, were exported. Notes analysis made by A. H. Church. (J. F. J.)

939. [Anon.] **Exportation de Champignons néo-zélandais en Chine.** <Rev. Sci. Nat. Appli., vol. XXXVIII, Paris, Aug. 5, 1891, pp. 237–238.

Note from a Kew Bulletin on the chemical composition and commercial importance of *Hirneola polytricha*. (E. F. S.)

940. BING, F. G. **Curious growth of fungi.** <Science Gossip, No. 325, London, Jan., 1892, p. 22, ⅛ col.

Describes a specimen of *Agaricus* sp. (?) in which three individuals were united. Notes also that where turf had been removed the place was marked by a ring of toadstools. (J. F. J.)

941. ELLIS, J. B., and EVERHART, B. M. **Mucronoporus andersonii, n. sp.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, p. 79.

Description of species as given in title. (J. F. J.)

942. FISCHER, ED. **Beiträge zur Kenntniss exotischer Pilze. II. Pachyma cocos und ähnliche sklerotienartige Bildung.** <Hedwigia. Bd. XXX, Dresden, März u. April, 1891, pp. 61–103, pl. VI–XIII.

The paper deals with various tuberiform fungous bodies, most of which have long been known. On pages 62–79 is given a full description of *Pachyma cocos*, Indian bread, or tuckahoe, prefaced by a summary of our previous knowledge on the subject. The author describes the anatomy of the tuberiform bodies, recognizing three component parts, hyphæ, smooth, refractive bodies, and striated lumps, also highly refractive. All of these are considered to be of fungous nature and the author shows that the hyphæ are changed into the refractive bodies, and that often the two can be seen still in actual connection and the intermediate stages of the change traced. Intermediate stages can also be observed between the refractive bodies and the striated lumps. Then the author gives a description of the connection of the *Pachyma* with the roots of trees in two specimens at his disposal. In both cases the wood was of a dicotyledonous plant, and not of a conifer, which is opposed to a prevailing idea as to their mode of occurrence. The hyphæ were found to enter the wood cells, swell up to refractive bodies and finally to dissolve the wood. On pages 79–97 the sclerotium of *Polyporus sacer* Fr. is fully described and illustrated with plates. The sclerotium is composed of delicate hyphæ, rounded or oval refractive bodies, much like starch grains in appearance, and smaller swollen thick-walled cells rich in protoplasmic contents. The oval bodies show concentric stratification when treated with KHO or other solvents. They are not connected with the hyphæ, though very rarely one could be seen that bore a filamentous prolongation. The author concludes, however, that the oval bodies arise from the hyphæ, as do the irregular refractive bodies of *Pachyma*. Considers *Polyporus scleropodius* Lév. as very probably the same as *Polyporus sacer* Fr. On pages 97–102 short accounts are given of *Tuber-regium* producing *Lentinus tuber-regium* Fr. and a number of other *Lentinus*-producing sclerotia; of *Mylittia lapidescens* Horan. producing *Agaricus* (*Omphalia*) *lapidescens* (Horaninow) F. Conn. and J. Schroeter; of *Sclerotium stipitatum* Berkeley, which the author considers as being a fructification of a fungus and not a sclerotium; and finally a notice of *Pietra fungaja* of south Italy, which produces *Polyporus tuberaster* Jacq. (W. T. S.)

943. Fischer, Ed. **Nachtrag zur Abhandlung über Pachyma cocos.** <Hedwigia, Bd. xxx, Dresden, Juli u. August, 1891, pp. 193–194.

Supplementary to No. 942; adds a notice of a paper by J. Schrenk and one by H. N. Ki... which had not been seen by the author when the original paper was written. Con... reference to the views of Murray as to the identity of *Lentinus scleroticola* Murray and *L. cyathus* B. & Br. (W. T. S.)

944. Fischer, Ed. **Notice sur le genre Pachyma.** <Rev. Mycol., vol. xiii, Toulouse, Oct., 1891, pp. 157–160.

Shows that the coralloid refringent bodies are of fungous origin and in direct connection with the hyphæ of the sclerotium. Describes their formation, and the relation of the ... to the wood of the host. Judging from the resemblance of *P. cocos* to *P. malacense* the author is inclined to the belief that the former is also a sclerotium form of a Hymenomycete. In the case of *P. malacense* he shows that the *Polyporus* growing from it is produced from the hyphæ of the sclerotium. (E. A. S.)

945. Griset, Henry E. **Large fungi.** <Science Gossip, No 322, London, Oct., 1891, p. 239, $\frac{1}{6}$ col.

Gives dimensions of specimens of *Lycoperdon giganteum* and *Phallus impudicus*. One of the former was 11 inches "long;" another was 22½ inches in circumference. The *Phallus* was 9¾ inches high with a stipe 1¼ inches in diameter. (J. F. J.)

946. Griset, Henry E. **Observations on Phallus impudicus.** <Science Gossip, No. 325, London, Jan., 1892, pp. 16–17, fig. 3.

Describes appearance and growth of the fungus with mention of measurements of a large specimen, 13 inches high, pileus 3½ inches long, column 2 inches in diameter, volva 4 inches long and ½ half inch thick. (J. F. J.)

947. Hariot, P. **Sur quelques champignons de la Flore d'Oware et de Bénin de Palisot Beauvois.** <Bull. Soc. Mycol., France, vol. vii, fasc. 4, Paris, Dec. 31, 1891, pp. 203–207.

Gives a historical discussion of the genus *Favolus*, notes on the synonomy of *Daedalea amanitoides* (Pal.) Beauv., and notes and description of the genus *Microporus* Pal. To these are added the descriptions of two new species of *Hexagona*, *H. deschampsii*, and *H. ...* (E. A. S.)

948. K. ——. **Review of "Illustrations of British fungi," by M. C. Cooke.** <New Zea. Journ. Sci., new ser., vol. i, Dunedin, Nov., 1891, pp. 264–265.

Brief notice of the book, with mention of fact that only 30 species of Agaricini have been so far described from New Zealand. (J. F. J.)

949. Kirtikar, K. R. **Notes on a rare fungus growing on the drumstick tree.** <Jour. Bombay Nat. Hist. Soc., vol. vi, Bombay, 1891, pp. 219–222, pl. A.

Describes species growing on *Moringa pterygosperma*, for which, if new, the name *Agaricus (Pleurotus) moringanus* is proposed. (J. F. J.)

950. Massee, George. **Mycological Notes. II.** <Jour. Mycol., vol. vi, Washington, April 30, 1891, pp. 178–184, pl. 1 (vii).

Gives notes on many species, with changes in nomenclature, and describes the following as new: *Sarcomyces* n. gen., *Dacryopsis* n. gen. (J. F. J.) (See No. 636.)

951. Meschinelli, L. **Di un probabile agaricino miocenico.** <Atti d. Soc. Veneto-Trentina di Sc. Nat., vol. xii, Padova, 1891 (1892), pp. 310–312, pl. 1.

Describes a fossil species of Agaricus in honor of Lester F. Ward, *Agaricus wardianus*, collected at Chiavon, in the Province of Vicenza, situated in the ash-colored marls belonging to the Aquitanian, corresponding in part to the base of the strata of Sotzka, and belonging like it to the base of the lower Miocene. The author figures peculiar perpendicular and horizontal striations upon the fossil which have no analogues in living species and make the determination doubtful. Microscopic examination revealed no spores or hyphæ. (D. G. F.)

952. Moxon, R. **Huge puffballs.** <Science Gossip, No. 323, London, Nov., 1891, pp. 261–262, $\frac{1}{8}$ col.

Records a specimen of *Lycoperdon giganteum*, found in Surrey, 36 inches in circumference and 34 inches round the top. (J. F. J.)

953. Patouillard, N. **Podaxon squamosus, nov. sp.** <Bull. Soc. Mycol., France, vol. vii, Paris, Dec. 31, 1891, p. 210, pl. 1 (xiii).

Gives a technical description of the fungus and an uncolored plate, natural size. (E. A. S.)

954. Prillieux & Delacroix. **Hypochnus solani, nov. sp.** <Bull. Soc. Mycol., France, vol. vii, Paris, Dec. 31, 1891, pp. 220–221, fig. 1.

Gives popular and technical description of the fungus. (E. A. S.)

955. TANAKA, NOBUJIRO. **A new species of Hymenomycetous fungus injurious to the mulberry tree.** <Jour. Coll. of Sci. Imp. Univ. Japan, vol. IV, Tokyo, 1891, pp. 193–204, pl. 4.

Describes the morphology and discusses the systematic position of a fungus producing the disease known as "Mompa-byo." Fungus first attacks roots and spreads to parts above ground. Name proposed for it is *Helicobasidium mompa*. (J. F. J.)

956. VOGLINO, P. **Nota micologica.** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, April 6, 1891, pp. 550[350]–353.

Gives list with notes of fungi, mostly Hymenomycetes collected near Casale, citing a few not previously recorded for Italy. (D. G. F.)

(See also, Nos. 882 and 923.)

VI.—UREDINEÆ.

957. ANDERSON, F. W. **Notes on certain Uredineæ and Ustilagineæ.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 121–127.

Refers to species of Æcidium, Puccinia, etc., giving notes on synonomy. Describes as new *Æcidium palmeri* on *Pentstemon virgatus*, *Puccinia windsoriæ* var. *australis*, and *P. kamtschatkæ*, the last from the collection of the U. S. Explor. Expedition. Gives also notes on other species collected by the expedition. (J. F. J.)

958. BARCLAY, A. **On two autœcious Cæomata in Simla.** <Scien. Mem. by medical officers Army of India, part VI, Calcutta, 1891, pp. 65–69, pl. 1; also reprinted.

Describes a new variety *himalayensis*, of *Puccinia prenanthes* Pers. occurring on leaves of *Prenanthes brunoniana* Willd., and *Lactuca macrorhiza* Hook. f. All three stages were found and the author thinks the fungus is autœcious, though he did not succeed in definitely proving it. Figures of the species are given. Then he describes a new species, *Puccinia prainiana*. Author has found all stages of this fungus on *Smilax aspera* and succeeded in producing the spermogonia by infection with teleutospores. Gives figures of the species. General remarks are appended on the *Cæomata* calling attention to the fact that they have been supposed to be connected with species of *Melampsora*. The author contends that this view is incorrect, as some *Melampsoræ* do not have *Cæomata* as æcidial stages and, moreover, the two *Pucciniæ* mentioned in the present paper have true *Cæomata* as æcidia. Thinks no longer a reason for maintaining the genus *Cæoma*. (W. T. S.)

959. BARCLAY, A. **Rhododendron Uredineæ.** <Scien. Mem. by medical officers Army of India, part VI, Calcutta, 1891, pp. 71–74, pl. 2; also reprinted.

Records finding of *Chrysomyxa himalense* Barclay on *Rhododendron hodgsoni* Hook. f. at Lingtu in Sikkin at 11,500–12,000 ft. The species was originally found on *R. arboreum*. Describes a new *Uredo* on *Rhododendron lepidotum* Wall., no specific name being given to the species. Also describes *Æcidium rhododendri* on *R. campanulatum* Don. Gives an interesting discussion of the relations between these forms and the *Uredineæ* on *Picea morinda* in India and *P. excelsa* in Europe. (W. T. S.)

960. CUBONI, G. **Sulla presenza di bacteri negli acervuli della Puccinia hieracii (Schumacher).** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, 6 April, 1891, p. 296.

Records the constant presence in the pustules of *Puccinia hieracii* on *Leontodon hastilis* of numerous colonies of bacteria which give to the spots a pallid diffused surrounding ring. The presence of the organisms seems confined to the older sori. Organisms not cultivated. (D. G. F.)

961. DIETEL, P. **Beschreibung einer neuen Puccinia auf Saxifraga.** <Hedwigia, Bd. XXX, Dresden, März u. April, 1891, pp. 103–104.

Description of *Puccinia pazschkei* on leaves of *Saxifraga elatior* from near Franzenshöhe, Tirol, and on *S. aizoon* from Switzerland. The differences between this species and *P. saxifragæ* Schlecht. are pointed out. (W. T. S.)

962. DIETEL, P. **Notes on some Uredineæ of the United States.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, pp. 42–43.

Discusses some statements made by F. W. Anderson (see No. 957) in regard to species of the genera *Uromyces* and *Puccinia*, disagreeing in certain particulars. (J. F. J.)

963. DIETEL, P. **Ueber Puccinia conglomerata (Str.) und die auf Senecio und einigen verwandten Compositen vorkommenden Puccinien.** <Hedwigia, Bd. XXX, Dresden, Sept. u. Oct., 1891, pp. 291–297, pl. 1 (XXXVI).

Gives critical notes on all *Pucciniæ* occurring on Senecio and related Compositæ. Many different species have been placed in *Puccinia conglomerata* (Str.) by recent writers. *P. Senecionis* Lib. (of which *P. subcircinata* Ell. and Ev. is a synonym) and *P. expansa* Link. should be restored to specific rank. *Puccinia glomerata* Grev., is thought to be probably nothing but the typical *P. expansa*; *P. tranzschelii* n. sp. on *Cacalia hastata* L., near Schenkursk (Prov. Archangelsk), Russia, is described, and in a supplementary note to the article it is reported from Siberia on the strength of a specimen collected by Martianow. *P. conglomerata*, *P. tranzschelii*, *P. senecionis*, *P. expansa*, and *P. uralensis* are figured in outline. (W. T. S.)

964. ELLIS, J. B, and EVERHART, B. M. **New species of Uredineæ and Ustilagineæ.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 118–121.

The following new species are described: ***Schrœteria annulata*** **in ovaries of** *Andropogon annulatus; Schizonella subtrifida* on *Circium ochrocentrum; Ustilago diplospora* in [illegible] *Panicum sanguinale; U. montaniensis* on *Muhlenbergia glomerata; Æcidium* [illegible] on *Castilleia; Æ. eurotiœ* on *Eurotia lanata; Uromyces scaber* on **grass**; *Puccinia* [illegible] on *Arabis* sp.; *P. araliæ* on *Panax trifolium; P. xanthiifolia=P. compositarum* [illegible] on *Iva xanthiifolia*, and *P. consimilis* on *Sisymbrium linifolium*. (J. F. J.)

965. ERIKSSON, J. **Noch einmal Æcidium Astragali, Eriks.** <Bot. Notizer, Lund, 1891, pp. 40–43.

Finds it necessary to change name of *Æcidium astragali* Eriks., on *Astragalus alpinus* published by the author in fas. VI, No. 285 of his Fung. par. scand. on account of De T[illegible] species of same name in M. Univ., No. 1117, on *Astr. melilotoides*. Selects *Æcidium astragali alpini* as new name and gives following synonomy: *Æ. astragali*, Eriks., Fung. par. sc. [illegible] No. 285. *Æ. carneum*, Nees., Bot. Notizer, 1884, p. 155. *Uromyces lapponicus* L[illegible] (Æcidium form), Bot. Notizer, 1890, p. 274. Does not consider his species as æcidial form of Lagerheim's *Uromyces*. (Theo. Holm.)

966. GALLOWAY, B. T. **A new pine leaf rust.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, p. 44.

Describes a new species under name of *Coleosporium pini*. (J. F. J.)

967. ELLIS, J. B., and TRACY, S. M. **New species of Uredineæ.** <Jour. Mycol., vol. VII, Washington, Sept. 10, 1891, p. 43.

Describe the following new species: *Puccinia hemizoniæ* on *Hemizonia truncata; Æcidium oldenlandianum* on *Houstonia cœrulea;* and *Æ. malvastri* on *Malvastrum* [illegible] (J. F. J.)

968. HARIOT, P. **Notes critiques sur quelques Uredinees de l'Herbier de Muséum de Paris.** <Bull. Soc. Mycol., France, vol. VII, Paris, Sept. 30, 1891, pp. 141–149.

Notes on type specimens in cryptogamic herbarium of the Paris Museum and of the Faculty of Science at Marseilles, together with a description of several new species from different places. The following new species are described: *Uromyces cachrydis* on stems and petioles of *Cachrys; Melampsora passifloræ* on *Passiflora lutea; Puccinia longicornis* Pat. & Har. on leaves of *Bambusa; Uredo cornui* on leaves of *Euphorbia; Æcidium dichondræ* on leaves of *Dichondra; Æ. vieillardi* on leaves of *Rubiaceæ*. The following changes in nomenclature are suggested: *Uromyces acutatus* Fckl. is restricted to the host *Gagea* [illegible]*sis* and is a synonym of *U. ornithogali* (Schlect.) Lév. *Puccinia porri* (Sow.) Wint. should include *Uredo ambigua* DC., *Uromyces ambiguus* (DC.) Fckl. and *Puccinia mixta* F[illegible] *Melampsora pistaciæ* Cast., does not belong to the *Uredineæ*. *Melampsora petrucciana* Cast. is not on *Glechoma* and equals *M. helioscopiæ* Pers. *Cronartium gramineum* Mont. is a gall. *Puccinia galii* (Pers.) Schw. should include as synonyms *P. crucianellæ* Desmaz., *Uredo galii-veri* Cast., and *Æcidium galii* Pers. *P. hieracii* (Schum.) Mart. includes *P. hieracii-murorum* Cast. and *P. centaurea-aspera* Cast. on *Centaurea aspera*. *P. centaurea-aspera* Cast. on *Picnomon acarna* belongs to *P. tanaceti*. *Puccinia bullata* (Pers.) Schroet. includes *P. apii-graveolentis* Cast., *P. apii* Cda., *P. apii* Desmaz., and *P. castagnei* Thüm. *P. B*[illegible]*leyi* Pass. is a synonym of *P. vincæ* Cast. *P. alii* Cast. on *Allium ampelopnasum=P.* [illegible] (DC.) Rud. *P. kraussiana* Cke. can not be maintained and is merged into *P. ferr*[illegible] Lév. *P. arenariæ* (Schum.) Schroet. has as synonyms *P. montagnei* de Toni, *P. ker*[illegible] Ung., and *P. corrigiola* Chev. The synonymy of *P. enicioleracei* Desm. is as follows: *P. asteris* Duby, *P. cirsiorum* Desmaz., *P. silphii* Schw., *P. xanthii* Schw.? *P. levcilleana* de Toni was previously described by Montagne as *P. levcillei*. *P. jurinæ* Rab. is only a variety of *P. pulvinata* Rab., and this should probably include *P. jurinæ* Cke. *Coleosporium baccharidis* (Lev.) Cke. includes *Uredo baccharidis* Lev., *Col. baccharidis* Cke., and the so-called Æcidium portion of *P. evadens* Wint. (No. 3208, F. Europæi). *Uredo baccha*[illegible] Speg. is a synonym of *U. balansæ* Har. *U. avenæ* Cast. and *U. glumarum* Rob. are synonyms of *P. rubigo-vera* (DC.) Wint. *Uredo beticola* Bell.=*Uromyces betæ* (Pers.) Kühn. *Uredo camphorosmæ* Cast.=Uredo spores of *Uromyces salicorniæ* (DC.) DBy. *Uredo cuc*[illegible] Desmaz. and *U. lychnidearum* Desm. are the Uredo form of *P. silenes* Schrœt. *Uredo* [illegible]*chœni* Cast. is on *Juncus* and equals *Uromyces junci* (Desm.) Tul. *Uredo ilicis* Cast.=*[illegible] quercus* de Brond. It is perhaps a *Melampsora*. *Uredo kleiniæ* Mont.=*Coleosporium senecionis* (Pers.) Fr. *Uredo phyllariæ* Cast. on *Phyllirea angustifolia=Cœoma phillyræ* (Cke.) Thum. and Bagn., but Castagne's name is the older. *Uredo poæ-sudeticæ* West. is the Uredo of *P. poarum* Niels. *P. pruni* Pers. includes *Uredo pruni* Cast., *Uromyces amygdali* Passer., and *Uredo castagnei* Mont. *Uredo scirpi* Cast. belongs to *Uromyces lineolatus* (Desm.) Schrœt. The same species is also in Castagne's herbarium under the name *Uredo prismaticus*. *Uredo tropæoli* Desm.=*Cœoma tropæoli* (Desm.) *Uredo anagyridis* Roussel=*Uromyces anagyridis* (Roussel) Roumeg. *Uredo andropogoni* Cast. corresponds exactly to *P. cesatii* Schrœt. *Uredo dianthi* Cast. is a synonym of *Uromyces caryophyllinus* (Schrank) Schrœt. *Uredo erigeronis* Requien upon *Cupularia viscosa* and *Æcidium sonchi* West, belongs to *Coleosporium sonchi* (Pers.) Lév. *Uredo lolii* Cast. belongs to *P. graminis* Pers. *Uredo polygonorum* v. *aviculare* Cast.=*Uromyces polygoni* (Pers.) Fckl. *Uredo saturciæ* Cast.=*P. menthæ*. *Uredo tumida* Gachet on *Populus balsamifera=Melampsora populina* (Jacq.) Lév. *Uredo berberidis* Lév. and probably *Uredo æcidiiformis* Speg. are synonyms of *Cœoma berberidis* (Lév.) Har. *Uredo cyclostoma* Lév.=*Cœoma cyclostoma* (Lév.) Har. *Æcidium ferulæ* Cast.=*Æcidium ferulæ* Roussel. *Æcidium glechomæ* Gaillard can not be distinguished from an *Æcidium* found by Brébison on *Teucrium scorodonia*. *Æcidium trifolii-repentis* Cast. is the *Æcidium* of *Uromyces trifolii* (Hedw.) Lév. *Æcidium scorzoneræ* Cast. belongs to *Puccinia tragopogonis* (Pers.) Cda. (E. A. S.)

969. Hariot, P. **Sur quelques Urédinées.** <Bull. Soc. Mycol., France, vol. VII, Paris, Dec. 31, 1891, pp. 195–202.

The author has examined a large number of Montagne's species, and in this article gives notes and complete descriptions of many species. Gives the following notes on synonomy: *Æcidium scillinum* D. R. & Mont. does not seem to differ from the *Æcidium* of *Uromyces erythronii* and is equally like *Æ. asphodeli* Cast. *Uromyces sisyrinchii* Mont. is the uredospore state of *Puccinia sisyrinchii* Mont. *Uromyces placentula* Mont. was communicated by Berkeley under the name *Uredo placentula*, but is only the uredo of *Puccinia pruni* Pers. *Uredo pruni* Mont. can not be separated from *Puccinia pruni* Pers. *Uredo microcelis* Mont. is a poorly developed specimen of *Uromyces limonii* (DC.) Lév., and *Uredo statices* B. & C. (North Pacific expl. expd., No. 135) belongs to the same species. *Uredo planiuscula* Mont. is the uredospore state of *Uromyces rumicis* (Schum.) Wint. *Uredo bellidis* D. R. & Mont. and a fungus in Montagne's herbarium under the name of *Æcidium purpurascens* D. R. and Mont. are both forms of *Puccinia hieracii* (Schum.) Mart. Besides these species from Montagne's herbarium the article also contains notes on some other Uredineæ studied by the author. *Uredo japonica* B. & C. (Pacific expd., No. 134) = *Uromyces japonicus* Berk. *Puccinia cardui* Plowright should be referred to *P. cnici-oleracei* Desmaz. (E. A. S.)

970. Hariot, P. **Uromyces des légumineuses.** <Rev. Mycol., vol. XIV, Toulouse, Jan. 1, 1892, pp. 11–22.

A list of 35 species of Uromyces on Leguminosæ, with notes and in some cases full descriptions. The number of species as usually counted is reduced in some cases by uniting several species. The following changes are made: *Uromyces fabæ* (Pers.) DBy. = *Uromyces viciæ* Fckl., *U. lathyri* Thüm. on *Lathyrus pisiformis*, *sylvestris*, and *Vicia*, *Uredo longipes* Lasch. or *leguminosarum*, and *Uromyces ervi* West. *Uromyces trifolii* (Hedw.) Lév. = *Uredo fallens* Desm., *Uromyces cytisi* Thüm. on *Caraganum purpureum*, *Uredo caraganæ* Thüm. on *Caraganum arborescentem*, *Uromyces onobrychidis* Lév., *Uredo onobrychii* Desm., and *Æcidium elegans* B. & C. on *Trifolium carolinianum*. *Uromyces appendiculatus* (Pers.) Lk. = *Uredo leguminum* Desm., *Uromyces dolichi* Cke., *Æcidium candidum* Bonorden, *Cæoma apiculosum* Bonord. *Uromyces pisi* (Pers.) DBy. = *Uredo lathyri* Bellynck, *Uredo viciæ-craccæ* Bellynck. *Uromyces striatus* Schr. = *Uromyces trifolii* Fckl. Fung. Rhen. No. 386. *Uromyces lespedezæ* (Schw.) Pk. = *U. macrosporus* B. & C.; *Uromyces solidus* B. & C. *Uromyces lupini* B. & C. = *Uromyces astragali* var. *lupini* B. & C. *Uredo lupini* B. & C. This species is distinct from *Uromyces lupini* Sacc. and from *U. astragali*. *Uromyces astragali* (Opiz.) Sacc. includes as synonyms *U. oxytropidis* Kng. in Rab. F. Eur. No. 1793; *U. cytisi* Schr. in ibid No. 2671; *Uredo oxytropidis* Pk. Winter has united some species to *Uromyces genistæ-tinctoriæ*, which should be separated from it—*U. anthyllidis*, *U. anagyridis*, *U. ononidis*, *U. trigonellæ*, *Uromyces*, and *Uredo lupini* (not B. & C.)—which ought to be referred to the following species: *Uromyces astragali*, *U. punctatus*, *U. oxytropidis*, which belong to *U. astragali*. *Uromyces pteleacearum* Rab. F. Eur. No. 93 has the host wrongly named, and is *U. genistæ* on *Laburnum*. The following must be omitted from the synonyms of *U. genistæ-tinctoriæ*: *U. cytisi* Schroet. F. E. No. 2731; *U. cytisi* Thüm. M. V. No. 1728; *Uredo caraganæ* on *Carag. arborescens*, *Uromyces onobrychidis* Lev. *Uromyces anthyllidis* = *U. anagyridis* (Roussel) Roum.; *U. lupini* Sacc. (not B. & C.); *U. ononidis* Passer, in Rab. F. Eur. No. 1792; *U. trigonellæ* Passer in Thüm. H. Œcon. No. 118; *U. trigonellæ* Pat. *Uromyces minor* Schroet. should include *U. trifolii* (Wettstein) on *Trif. montanum* in Fl. Exsicc. Austro-Hung. No. 1563. *Uredo hedysari* Thüm. M. V. No. 1932 on *Hedysarum setigerum*, from Siberia, does not belong to *Uromyces hedysari* (DC.) Fckl., but to *Uromyces astragali*. *Urom. haszlinskii* de Toni should be added to the synonyms of the latter. *Uromyces lapponicus* Lagerh. = *Æcidium astragali* Thüm. M. V. No. 1117; *Æ. astragali* Eriksson, F. par. Scand. No. 285; *Æ. astragali-alpini* Eriks., ibid.; *Æ. carneum*, de Lagerh.; *Æ. oxytropidis* Thüm. The following species are excluded: *U. mucunæ* Rab., *U. sphæropleus* Cke., *U. pseudarthriæ* Cke., *U. versatilis* Pk., *U. tepperianus* Sacc. (E. A. S.)

971. Hisinger, Eduard. **Puccinia malvacearum, Mont. hunnen till Finland, 1890.** <Bot. Notiz. Lund, 1891, pp. 44–45.

Notes spread of species from Chili, where first discovered, in 1852, to various parts of Europe. Quotes Eriksson as reporting it in Aragonia in 1869, as appearing in Bordeaux in 1871, in England in 1873, as spreading through Germany to Austria, Italy, Holland, and Denmark, only appearing in Sweden in 1882, and not reaching the northern part before 1887. Finally (1890) reports it from Finland. (Theo. Holm.)

972. Howell, J. K. **The trimorphism of Uromyces trifolii (Alb. and Schw.), Wint.** <Proc. Am. Asso. Adv. Sci., vol. XXXIX, July, 1891, Salem, Mass., pp. 330–331.

Gives results of experiments, showing that the *Æcidium* growing on clover is a form of *Uromyces trifolii*. (See Nos. 151 and 209.) (J. F. J.)

973. Lagerheim, G. de. **Om förekomsten af europeiska Uredinéer på Quito's högslätt.** <Bot. Notiser, Lund, 1891, pp. 63–66.

The author has found *Puccinia coronata* on specimens of *Avena*, the seeds of which had been introduced from Europe. Calls attention to the fact that none of the species of *Rhamnus*, said to be the bearers of the Æcidium form, have yet been observed in Ecuador. The only possible explanation of the occurrence of this *Puccinia* in Ecuador will therefore be to suppose that the Æcidium-form has been omitted entirely. Similar observations have been made by Plowright (The connection of wheat mildew (*Puccinia graminis* Pers.) with the Barberry-Æcidium (*A. berberidis* Gmel.), Records of the Woolhope Transactions, Hereford, 1887), who succeeded in infecting young plants of wheat directly with sporidia of *Puccinia graminis*. This last fungus has also been found in Ecuador, although the species of *Berberis* and *Mahonia*, upon which the Æcidium form is said to occur, are wanting. The author has found, however, an Æcidium upon *Berberis glauca*, but this seems to belong to a *Diorchidium*, hitherto unknown, and occurring on the same *Berberis*. The author describes a new species, *Fusarium uredinis*, parasitic on the Uredo form of *Puccinia graminis*. (Theo. Holm.)

974. LAGERHEIM, G. DE. **Pucciniosira, Chrysospora, Alveolaria und Trichospora, neue Uredineen-Gattungen mit tremelloider Entwickelung. (Vorläufige Mittheilung.)** <Ber. d. deutsch. bot. Gesell., 9. Jahrg., heft 10, Berlin, Jan. 24, 18[illegible], pp. 344–348.

Gives a preliminary notice of four interesting new genera of tremelloid *Uredineæ*. *Pucciniosira* resembles *Endophyllum*, but has two-celled smooth spores. Two species described. *P. triumfettæ* on leaves of *T.* sp. in Equador and on *T. abutiloides* in [illegible] colorless spores, which have attached to them the empty intermediate cell and [illegible] apart into two cells in germinating. Only teleutospores are described. The second, *P. solani* on leaves of *Solanum* sp. in Equador, differs much from the first; the spores produced in chains which adhere to each other laterally. The spores are orange [illegible] in germinating fall apart into two cells. The intermediate cells disappear early in the development of the fungus and nothing can be seen of them when the spores are [illegible]. Spermogonia and teleutospores occur. In a footnote it is mentioned that a *Lep*[illegible] occurs on *Cestrum*, and another on *Solanum* in Equador, making with *Pucciniosira* [illegible] tremelloid *Uredineæ* known on the family Solanaceæ, though none were previously [illegible]. *Chrysospora* has bright red sori containing teleutospores like *Puccinia* in structure [illegible] germinating each cell divides into four segments, each of which produces a large sp[illegible] on the end of a unicellular promycelium. The genus resembles, therefore, a *Coleosporium* in which the teleutospores become segmented just before germination. Spermogonia and teleutospores occur. A single species, *C. gynoxidis*, is described which occurs on leaves [illegible] occasionally on young shoots of *Gynoxis pulchella* DC. and *G. buxifolia* DC. in Equador. *Alveolaria* produces cylindric ringed columns consisting of a series of disk-like teleutosp[illegible] which are composed of many prismatic cells. The cells have a smooth membrane [illegible] spore disks ripen in basipetal order and are loosened in germination, which proceeds as [illegible] *Puccinia*. Only teleutospores are produced. Two species are described. The first, *A. cordiæ*, occurs on leaves of *Cordia* sp. in Equador and has spore-disks 120-150 μ wide [illegible] 40–50 μ high, consisting of 30 to 60 cells which have yellowish walls and colorless contents. The second, *A. andina*, occurs on a very different *Cordia* in Equador and [illegible] spore disks 180-210 μ wide and about 70 μ high, composed of very numerous cells which have bright orange-colored contents. *Trichospora* has filiform orange-yellow sori similar in structure to those of *Cronartium* and composed of more or less spool-shaped teleutospores and sterile cells. The membrane of the teleutospores is colorless and thickened at the [illegible] the contents are orange red. The sterile cells, which occur among the teleutospores are very narrow and long and contain a reddish cell content. The germination of the teleutospores is very different from that of *Cronartium*. The young spores are unicellular [illegible] when ripe are divided by three delicate septæ into four cells, each of which produces in germinating a unicellular promycelium with a single sporidium. One species, *T. tournefortiæ* [illegible] described. It is very common in Equador on all parts of two species of *Tournefortia*. Both spermogonia and teleutospores are produced. The spermogonia are unusually large and have spermatia with red cell contents. (W. T. S.)

975. MAGNUS, P. **Eine Bemerkung zu Uromyces excavatus (DC.) Magn.** <Hedwigia, Bd. xxx, Dresden, Juli u. Aug., 1891, pp. 196–197.

States that the name of the fungus should be *Uromyces excavatus* (DC.) Magn., not *U. excavatus* (DC.) Berk. It is different from *U. excavata* (DC.) of Berkley and of Cooke, which is really *U. tuberculatus* Fckl. (W. T. S.)

976. NEWCOMBE, F. C. **Perennial mycelium of the fungus of blackberry rust.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, p. 106, pl. V, VI.

Describes features presented by blackberry cane affected with rust, *Cæoma nitens*. Concludes mycelium to be perennial (see No. 822). (J. F. J.)

977. PIROTTA, R. **Sulla Puccinia gladioli Cast. e sulle Puccinie con parafisi.** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, 5 Ottobre, 1891, pp. 578–581.

Records *Puccinia gladioli* Cast. on *Romulea ramiflora* Ten., a new host, as possessing paraphyses. Refers to omission of the species from Schroeter and Winter, and imperfect description of geographical distribution by Saccardo & Celotti, giving corrections and [illegible] synonomy. Discusses presence of paraphyses in Puccineæ, preferring to consider them as constituting secondary characters only. Adds list of species with paraphyses as follows: *P. anemones-virginianæ* Schw., *P. gladioli* Cast., *P. virgaureæ*, *P. allii*, *P. polygoni-amphibii* Pers., *P. sonchi* Rab., *P. pruni-spinosæ* Pers., *P. rubigo-vera*, *P. cordæ* Bagn., *P. gibberosa* Lagerh. (D. G. F.)

(See also Nos. 692, 723, 736, 742, 764, 864, 873, 895, 923, 925, 979, and 998.)

VII.—USTILAGINEÆ.

978. ELLIS, J. B., & ANDERSON, F. W. **A new Ustilago from Florida.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, pp. 116–117.

Describe new species on *Heteropogon melanocarpa* as *Ustilago nealii*. (J. F. J.)

979. PIROTTA [R.]. **[Due funghi non comuni in Italia.]** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, 6 April, 1891, p. 296.

Notice by secretary of society that Pirotta illustrated briefly before the Society *Ustilago panici-miliacei* on millet, and *Puccinia grisea* on *Globularia vulgaris*, noting them as rare in Italy. (D. G. F.)

980. PIROTTA, R. **Sull'Urocystis primulicola Magnus in Italia.** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, 1 Luglio, 1891, p. 502.

Calls attention to error in Godfrin's article in Bull. Soc. Bot., France, t. XXXVIII, 1891, p. 68, in which the author's paper in N. Gior. Bot. Ital., 13, 1881, p. 235, is given as authority for presence of the fungus in Italy, when in fact the material referred to in the paper was sent to Pirotta from near Gotha by DeBary. Adds that the fungus has been recorded by Cocconi and Morini in 1886 from near Bologna, and published in Mem. Acad. Sc. di Bologna, ser. IV, t. VI, p. 373. (D. G. F.)

(See also Nos. 692, 698, 716, 723, 877, 923, 957, and 964.)

VIII.—ASCOMYCETES.

a.—*Gymnoasci.*

981. MASSALONGO, C. **Sulla scoperta in Italia della Taphrina epiphylla Sadebeck.** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, 1 Luglio, 1891, pp. 325–327.

Reports the discovery of the species in the province of Verona near Bolca, and gives synonomy of the species, referring to Sadebeck's work on irritant action of parasite on host. (D. G. F.)

b.—*Perisporiaceæ.*

(See No. 764.)

c.—*Sphæriaceæ.*

982. [Anon.] **The Chinese insect-fungus drug.** <Insect Life, vol. IV, Washington, Dec., 1891, pp. 216–218, fig. 2.

Refers to *Cordyceps chinensis*, a fungus infesting grubs and used in China as a medicine. Quotes account given by A. C. Jones, U. S. consul at Chinkiang, China. (J. F. J.)

983. FAIRMAN, C. E. **Observations on the development of some fenestrate sporidia.** <Jour. Mycol., vol. VI, Washington, May 14, 1890, pp. 29–31.

Describes development of sporidia in *Fenestella amorpha*, *Patellaria fenestrata*, and *Camarosporium subfenestratum*. (J. F. J.)

984. HALSTED, B. D. **Ergot and ergotism.** <Cult. and Country Gent., vol. LVI, Albany, Oct. 29, 1891, p. 871, fig. 1.

Gives popular exposition of the life history of *Claviceps pupurea* Tul., with methods of prevention of ergotism by careful cutting of suspected grain while in the bloom. (D. G. F.)

985. MASSEE, GEORGE. **A new Cordyceps.** <Ann. of Bot., vol. V, London, Nov., 1891, pp. 510–511, fig. 5.

Describes *C. sherringii*, n. sp., parasitic on an ant from Granada, S. America. Discusses relation of species to others in same genus and in *Oomyces*, *Epichloe*, and *Claviceps*. Mentions particularly *Cordyceps robertsii* from New Zealand. (J. F. J.)

986. REHM. **Die Discomyceten-Gattung Ahlesia Fuckel und die Pyrenomyceten-Gattung Thelocarpon Nyl.** <Hedwigia, Bd. XXX, Dresden, Jan. u. Feb., 1891, pp. 1–12.

Ahlesia is according to the author not a *Discomycete*, as Fuckel thought, but a hypocreaceous *Pyrenomycete* closely allied to *Chilonectria* and *Aponectria* (which in his estimation should not be separated). The genus *Thelocarpon* of Nylander placed heretofore in pyrenocarpous lichens is really the same as *Ahlesia*, and being an older name must be adopted and placed in Hypocreaceæ. The green gonidia found often in the base of the perithecia are looked upon as algæ, either living in symbiose with the fungus or accidentally present. On pages 4–12 is given a descriptive monograph of the 16 known species of *Thelocarpon*. *Ahlesia lichenicola* Fuckel is placed in the genus for the first time as *T. ahlesii* Rehm. (W. T. S.)

987. STARBÄCK, K. **Bidrag till Kännedomen om Sveriges ascomycetflora.** <Bihang till Kgl. Svenska Vetenskaps Akad. Handlingar, vol. XVI, Afdelning 3, 1891, Stockholm, pp. 1–15, pl. 1.

The following are described and figured as new: *Diaporthe rehmiana* on *Ulmus montana*; *Leptosphæria lasiosphærioides* on *Aconitum lycoctonum*; *Herpotrichia mucilaginosa* on *Juniperus communis*; *Cryptoderis oligotheca* on *Thalictrum alpinum*; *Sphærulina dryadis* on *Dryas octopetala*; *Starbäckia* n. gen.; *S. pseudotriblidioides* on pine wood. (Th. Holm.)

(See also Nos. 736, 740, 753, 764, and 769.)

d.—*Discomycetes.*

988. BOUDIER, EM. **Description de trois nouvelles espèces de Pezizes de France de la section des Operculées.** <Bull. de la Soc. Mycol., France, vol. VII, Paris, Dec. 31, 1891, pp. 214–217, pl. 1 (XV).

Describes *Disciotis maturescens*, *Galactinia michelii*, and *Sepultaria nicæensis*. Adds notes as to habitats, etc. (E. A. S.)

989. OUDEMANS, C. A. J. A. **Phacidium pusillum Libert.** <Hedwigia, Bd. XXX. Dresden, Sept. u. Oct., 1881, pp. 248–250.

The author found specimens and investigated them in the fresh condition in the s... of 1891. As a result of his studies he amends and completes Libert's description and co... some statements of Roumeguère and Saccardo regarding the species. (W. T. S.)

(See also Nos. 950 and 986.)

IX.—IMPERFECT AND UNCLASSIFIED FORMS.

a.—Hyphomycetes and Stilbeæ.

990. ATKINSON, GEO. **Some Cercosporæ from Alabama.** <Jour. Elisha Mitchell Scie. Soc., vol. VIII, pt. 2, Feb. 24, 1892 [separate pp. 36].

Discusses the position of *Cercospora* in classification and mentions the forms under ... it is known. Gives a brief sketch of life history of genus and notes paucity of know... in relation to complete life history of many species. Gives description of 79 species, ... few notes on synonomy and describes the following as new: *Cercospora tephrosiæ* on *T... sia hispidula; C. truncatella* on *Passiflora incarnata; C. agrostidis* on *Agrostis* sp.? ... *laris* Wint., var. *sagittati*, on *Polygonum sagittatum; C. anthelmintica* on *Chenopodium ... brosioides* var. *anthelminticum; C. jussiææ* on species of *Jussiæa; C. fusimaculans* on *Pan... dichotomum; C. setariæ* on *Setaria glauca; C. asterata* on *Aster* sp.? *C. richard...* *Richardia africana; C. alabamensis* on *Ipomœa purpurea; C. flagellifera* on *Galactia ... C. papillosa* on *Verbena* cult.; *C. solanicola* on *Solanum tuberosum; C. ludwigiæ* on *L... alternifolia; C. virginianæ* on *Diodia virginiana; C. erinospora* on *Rhyncospora* gl... *C. atromarginalis* on *Solanum nigrum; C. tropæoli* on *Tropæolum* cult.; *C. ... Eleusine ægyptica; C. seriata* on *Sporobolus asper; C. althæina*, var. *modiolæ* on *Mo... tifida; C. clitoriæ* on *Clitoria mariana; C. diospyri*, var. *ferruginosa; C. jatrophæ* on *Ja... stimulosa; C. macroguttata* on *Chrysopsis graminifolia; C. pinnulæcola* on *Cassia* ... *C. erythrogena* on *Rhexia mariana*, etc.; *C. rigospora* on *Solanum nigrum* (?); *C. cata...* on *Sambucus canadensis*, and *C. erechtites* on *Erechtites hieracifolia*. (J. F. J.)

991. MACMILLAN, C. **Note on a Minnesota species of Isaria and an attendant Pachybasium.** <Jour. Mycol., vol. VI, Washington, Sept. 10, 1890, pp. 75–76.

Describes features presented by *Isaria sphingum*, parasitic on a tussock moth, and *Pachybasium hamatum* (?), which appeared in a gelatin culture tube. Queries if the latter be ... a form of the *Isaria*. (J. F. J.)

992. MASSEE, GEORGE. **A new genus of Tuberculariesæ.** <Ann. of Bot., vol. V, London, Nov., 1891, p. 509, fig. 1.

Describes *Hobsonia*, n. gen. Berk., in herb., with n. sp. *H. gigaspora* Berk. in herb. [The figure is called *H. macrospora*.] From Venezuela. (J. F. J.)

(See also, Nos. 714, 716, 742, 747, 756, 764, and 903.)

b.—Sphæropsideæ and Melanconeæ.

993. CUBONI, G. **Diagnose di una nuova specie di fungo excipulaceo.** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, 5 Ottobre, 1891, p. 577.

Describes new genus and new species on decorticated wood of *Morus alba*, *Phaeodiscula celottii*, in honor of collector. Thinks genus should form a new section of the *Phæospo...*. (D. G. F.)

994. ELLIS, J. B., and EVERHART, B. M. **Leptothyrium periclymeni, Desm.** <Jour. Mycol., vol. VI, Washington, Jan. 6, 1891, p. 116.

Notes occurrence of species on *Lonicera* from Ontario and proposes to call it *Leptothyrium periclymeni*, var. *americanum*. (J. F. J.)

995. MARTELLI [U]. **[Alcuni funghi che attaccano le olive.]** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, April 6, 1891, p. 324.

Report of secretary of note presented to the society in regard to a new *Phoma* on olives likely to prove disastrous, which he proposes to call *P. pallens*, although reserving the description for a future meeting, together with that of an associated form, possibly the spermogonial form of the *Phoma*. (D. G. F.)

(See also, Nos. 716, 732, 744, 761, and 779.)

c.—Miscellaneous.

996. MUELLER, DR. J. **Critique de "l'Étude" du Docteur Wainio.** <Rev. Mycol., vol. XIV, Toulouse, Jan. 1, 1892, pp. 33–40.

An article written at the request of the editor of the Revue for the purpose of discussing the system of classification proposed by Dr. Wainio in an article on "The natural classification and morphology of the Lichens of Brazil." The author takes issue with Dr. Wainio on the main points of the original article. He rejects the theory of symbiosis, the definition of a lichen, and the characters used as a basis of classification. (E. A. S.)

97. STANLEY-BROWN, J. **Bernardinite: Is it a mineral or a fungus?** <Am. Jour. Sci., 3d ser., vol. XLII, New Haven, July, 1891, pp. 46-50.

Gives an account of the "mineral resin" described by Silliman in 1879. Gives analysis and general description of a specimen stated by Ellis to be *Polyporus officinalis* Fr. Found on *Pinus strobus* in various localities of the United States. (J. F. J.)

(See also, Nos. 654, 716, 832, 942, 943, and 944.)

G.—MORPHOLOGY AND CLASSIFICATION OF BACTERIA.

(See Nos. 720, 745, 886, and 933.)

H.—MORPHOLOGY AND CLASSIFICATION OF MYXOMYCETES.

(See Nos. 695, 716, and 855.)

I.—EXSICCATÆ.

998. PAZSCHKE, O., **Rabenhorst-Winter. Fungi Europæi et extraeuropæi. Cent. 38, Cura Dr. O. Pazschke.** <Hedwigia, Bd. XXX, Dresden, Juli u. August, 1891, pp. 197-200.

Gives a list of the species in the 38th century of this exsiccata and reprints a note on 3704, *Urocystis hypoxidis* Thaxter, from Brazil, and the descriptions of the following new species: *Puccinia pithecocteni* II and III on leaves of *Pithecoctenum* Brazil; *Uromyces dietelianus* on leaves of *Bauhinia* (*grandiflora*?) Brazil; *Uredo celtidis* on leaves of *Celtis*, Brazil; *Dichomera elæagni* Karst. on dead branches of *Elæagnus macrophylla*, Finland. (W. T. S.)

999. REHM. **Ascomyceten fasc. XXI.** <Hedwigia, Bd. XXX, Dresden, 1891, Sept. u. Oct., 1891, pp. 250-262.

This exsiccata after a long pause necessitated by the pressure of other work has been resumed and will be continued. In this article the names of the species in fasc. XXI, with synonomy and often with critical notes, are reprinted apparently as given on the labels. This fascicle includes Nos. 1001-1050 and 146b., 682b., 69b, c., 444b., 8b. The following new species are described: *Pezizella dilutelloides* on decayed petioles of *Robinia pseudacacia* near Berlin; *Tryblidaria subtropica* (Wint.) (=*Blitrydium subtropicum* Winter Hedw.. 1885, p. 263); *Cryptodiscus pusillus* (Lib.) (=*Phacidium pusillum* Libert Pl. arden, 268); *Phyllachora lagerheimiana* on living leaves of *Ilex scopulus* Panecillo, near Quito; *Strickeria tingens* Wagelin. in litt. on decorticated wood of *Fraxinus*, Switzerland; *Meliola lagerheimii* Gaillard on living leaves of *Ilex scopulorum*, Quito; *Sphærotheca gigantiascus* (Sorok. et Thüm.) Bäumler (=*Erysiphe gigantiascus* Sorok. et Thüm. Mycoth. in Sched.) on *Euphorbia palustris*, Pressburg, Hungary. (W. T. S.)

J.—TECHNIQUE.

1000. BOURQUELOT, EM. **Sur un artifice facilitant la recherche du tréhalose dans les champignons.** <Bull. Soc. Mycol., France, vol. VII, Paris, Dec. 31, 1891, pp. 208-209.

Gives a method of hastening the crystallization of trehalose by inserting in the solution a glass plate previously rubbed with a crystal of trehalose. The crystals collect about the portion of the glass thus prepared. Later they can be detached, and by scattering them crystallization will be provoked everywhere in the liquid. A footnote gives the method of first disposing of the mannite in the same solution. (E. A. S.)

1001. GAILLARD, A. **Note sur un procédé pour l'observation des champignons epiphytes.** <Bull. Soc. Mycol., France, vol. VII, Paris, Dec. 31, pp. 232-234.

Gives a method of observing the aërial parts of fungi by means of running over them a drop of collodion in solution and afterward transferring on the slide to glycerin jelly. By this means the fungus can be examined in its natural position. (E. A. S.)

1002. WAITE, M. B. **[Directions for collecting] fungi.** <U. S. Nat. Museum, Bull. No. 39, Washington, 1891, pp. 24-27.

Gives general directions for making collections of saprophytic and parasitic fungi. (J. F. J.)

J. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF VEGETABLE PATHOLOGY.

Vol. VII. No. 4.

THE JOURNAL OF MYCOLOGY:

DEVOTED ESPECIALLY TO THE STUDY OF FUNGI IN THEIR RELATION TO PLANT DISEASES.

EDITED BY

THE CHIEF OF DIVISION AND HIS ASSISTANTS.

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DIVISION OF VEGETABLE PATHOLOGY.

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PUBLICATIONS OF THE DIVISION OF VEGETABLE PATHOLOGY.

The Division of Vegetable Pathology, formerly a section of the Division of Botany, became a separate organization by act of Congress approved July 14, 1890. Since that date its bulletins have been numbered independently and in a separate series, but the following list includes the publications of the Division under its former as well as under its present organization. Nos. 1, 3, 4, and 6, omitted from the series of bulletins published by the Section of Vegetable Pathology, are publications of the Division of Botany, not relating to vegetable pathology. Only those documents marked with an asterisk are still on hand for distribution.

SECTION OF VEGETABLE PATHOLOGY, DIVISION OF BOTANY.

Journal of Mycology:

Vol. V, Nos. 1, 2, 3, 4. Pp. 249, pl. 14. 1889-'90.
Vol. VI, No. 1.* Pp. 44, pl. 2. 1891.

Bulletins:

No. 2. Fungous Diseases of the Grapevine. Pp. 136, pl. 7. 1886.
No. 5. Report on the Experiments made in 1887 in the Treatment of Downy Mildew and Black Rot of the Grape. Pp. 113. 1888.
No. 7.* Black Rot. Pp. 29, pl. 1. 1888.
No. 8.* A Record of some of the Work of the Division. Pp. 69. 1889.
No. 9. Peach Yellows: A Preliminary Report. Pp. 254, pl. 36, maps and diagrams 9. 1888.
No. 10. Report on the Experiments made in 1888 in the Treatment of Downy Mildew and Black Rot of the Grape. Pp. 61, pls. 2. 1889.
No. 11. Report on the Experiments made in 1839 in the Treatment of Fungous Diseases of Plants. Pp. 119, pl. 8. 1890.

Circulars:

No. 1. Treatment of Downy Mildew and Black Rot of the Grape. Pp. 3. 1885.
No. 2. Grapevine Mildew and Black Rot. Pp. 3. 1885.
No. 3. Treatment of Grape Rot and Mildew. Pp. 2. 1886.
No. 4. Treatment of the Potato and Tomato for Blight and Rot. Pp. 3. 1886.
No. 5. Fungicides or Remedies for Plant Diseases. Pp. 10. 1888.
No. 6.* Treatment of Black Rot of the Grape. Pp. 3. 1888.
No. 7.* Grapevine Diseases. Pp. 4. 1889.
No. 8. Experiments in the Treatment of Pear Leaf Blight and Apple Powdery Mildew. Pp. 11. 1889.
No. 9.* Root Rot of Cotton. Pp. 4. 1889.

DIVISION OF VEGETABLE PATHOLOGY.

Journal of Mycology:

Vol. VI. Nos. 2*, 3*, 4.* Pp. 163, pl. 16. 1890-'91.
Vol. VII, Nos. 1, 2, 3. Pp. 331, pl. 31. 1891-'93.

Bulletins:

No. 1.* Additional Evidence on the Communicability of Peach Yellows and Peach Rosette. Pp. 65, pl. 39. 1891.
No. 2.* The California Vine Disease. Pp. 222, pl. 27. 1892.
No. 3. Report on the Experiments made in 1891 in the Treatment of Plant Diseases. Pp. 76, pl. 8. 1892.
No. 4. Experiments with Fertilizers for the Prevention and Cure of Peach Yellows, 1889-'92. Pp. 197, pls. 33. 1893.
No. 5.* The Pollination of Pear Flowers. Pp. 110, pls. 12. 1894.
No. 6. Bordeaux Mixture as a Fungicide.
No. 7. The Effect of Spraying with Fungicidés on the Growth of Nursery Stock.

Farmers' Bulletins:

No. 4.* Fungous Diseases of the Grape and their Treatment. Pp. 12. 1891.
No. 5.* Treatment of Smuts of Oats and Wheat. Pp. 8, pl. 1. 1892.
No. 7.* Spraying Fruits for Insect Pests and Fungous Diseases. Pp. 20. 1892.
No. 15.* Some Destructive Potato Diseases. Pp. 8, figs. 3. 1894.
No. 17.* Peach Yellows and Peach Rosette. Pp. 20, figs. 7. 1894

Circulars:

No. 10.* Treatment of Nursery Stock for Leaf Blight and Powdery Mildew. Pp. 8, figs. 2. 1891.
No. 11.* Inquiry on Grape Diseases and their Treatment. P. 1. 1891.
No. 12.* Inquiry on Rust of Cereals. P. 1. 1891.
No. 13.* Inquiry on Peach Leaf Curl. Pp. 3. 1893.
No. 14 Inquiry on Rusts of Cereals. Pp. 3. 1894.

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VOLUME VII. No. 4. } JOURNAL OF MYCOLOGY. { ISSUED Aug. 15, 1894.

TREATMENT OF PEAR LEAF-BLIGHT * IN THE ORCHARD.

By M. B. WAITE.

[Plates XXXII, XXXIII.]

The experiments here described were carried on in the orchard of the Old Dominion Fruit Company, on the James River, near Scotland, Va. This orchard consists almost exclusively of standard Bartlett pears and contained originally 22,000 trees, of which at least 16,000 are still standing. The trees are now 19 years old and the greater part of them are in fairly good condition, except for pear leaf-blight, which for several years past has defoliated the trees during the month of July. This defoliation in midsummer deprives the trees of the use of their leaves during half of the season, and no doubt seriously interferes with their vigor. The cultivation has been fairly good. The trees were headed very low, and the lower branches, until the past season, extended nearly to the ground, but during the past winter they have been trimmed up. Most of the trees do not make a very strong growth, nor do they continue to grow long into the summer. Only occasionally does the general growth of twigs on a tree exceed 1 foot, and often it is much less. The fact that these trees have been regularly defoliated with leaf-blight made this an excellent place for experiment, particularly because of the availability of uniform blocks of similar trees.

The appearance of the disease in question year after year to about the same extent makes it an easy one to experiment upon. In 1892 five sprayings with the 50-gallon formula of Bordeaux mixture entirely prevented the leaf-blight. The dates of the sprayings were April 28, May 15 and 30, and June 14 and 29. At the time of the first treatment the young leaves were just fairly expanded. The object of the sprayings was simply to prevent the disease on about 160 trees as a part of another experiment of an entirely different character. The spraying was thoroughly done and the treated trees held their leaves to the close of the season and showed scarcely a spot of leaf-blight, while the

* *Entomosporium maculatum* Lév.

rest of the orchard became entirely bare by the 1st of August. It were thought at the time that five treatments were probably more than were necessary. The question then arose as to how few sprayings would be necessary to prevent the disease. It was deemed best, therefore, in planning this experiment to take the standard fungicide and find the least number of treatments that would prevent the disease and the best times for making them. On account of the beneficial results from spraying the experimental trees in 1892, the owners decided to spray the whole orchard in 1893. In doing this the suggestions of the Department were followed quite closely and a record of the work was kept, so that it furnishes an interesting example of the success of the treatment and its cost when done on a large scale.

The work, therefore, may properly be discussed under two heads. 1, an experiment to determine the least number of treatments with Bordeaux mixture necessary to prevent leaf-blight, and (2) an experiment to ascertain the actual cost of treating a large orchard with Bordeaux mixture four times.

TREATMENT TO PREVENT LEAF-BLIGHT.

The plan of the first experiment was as follows: A portion of the orchard was selected which was uniform and where there were few missing trees. Eight plats of 20 trees each (two rows of 10 trees each) were laid off side by side and numbered 1 to 8. A control plat of the same size as the numbered plats, 2 rows wide and 10 rows long, was left at the beginning of the series, and another at the end. Continuing from the second control plat, 8 duplicate plats were laid off and numbered 1^1 to 8^1. A third control plat followed 8^1.

Plats 1 and 1^1 were treated April 24, 1 treatment.
Plats 2 and 2^1 were treated May 1, 1 treatment.
Plats 3 and 3^1 were treated May 15, 1 treatment.
Plats 4 and 4^1 were treated June 1, 1 treatment.
Plats 5 and 5^1 were treated May 1 and 15, 2 treatments.
Plats 6 and 6^1 were treated May 1 and 15 and June 1, 3 treatments.
Plats 7 and 7^1 were treated May 1 and 15 and June 1 and 15, 4 treatments.
Plats 8 and 8^1 were treated June 1 and 15, 2 treatments.

It was desired to determine the most critical time in the treatment of the disease by making one single treatment at different times and observing which one did the most good. The Bordeaux mixture used was the 50-gallon formula, 6 pounds of copper sulphate in 50 gallons of water, with enough lime to neutralize all the copper. To avoid complications only the single strength of the fungicide was tried, and the experiment was limited to ascertaining the dates and the number of treatments. The spraying was superintended by Mr. W. H. Berryman, the manager of the orchard. The first application was made just after the trees had come apparently into full foliage, at which time no leaf-blight had yet appeared. The four treatments of plats 7 and 7^1 were given so as to be sure to prevent the disease, and the others were simply intermediates.

Results.—The orchard was visited and careful notes taken on August 2 and again on October 12. By August 2 the control plats had lost the greater part of their foliage. Scarcely one-fifth remained on these trees, and this was rapidly falling, it being badly affected by leaf-blight. The contrast between unsprayed and the sprayed foliage was very striking. All the sprayed trees, including the single treatments, looked exceedingly well as compared with the controls, except the trees sprayed April 24. These showed but little improvement over the unsprayed controls. The other plats, which had been sprayed once, while appearing to retain full foliage, had begun to shed their leaves. There were fewer spots on the leaves of the trees sprayed May 15 than on those sprayed May 1, and still less on those sprayed June 1. In fact, the latter appeared at that time to be an almost perfectly successful treatment and the plat was scarcely inferior to those which received two or even four treatments. By October 12 the controls and also the plat sprayed early were completely defoliated. All the trees were beginning to shed normally a little, so that slight differences had developed which were not apparent on the first visit. The conclusions from a study of these results are as follows:

(1) The earliest treatments gave the poorest results, and of the single treatments there was an increase in effect up to June 1. Between May 15 and June 1 there was but slight difference.

(2) Two sprayings (on May 1 and 15 or on May 1 and June 1) left so little to be desired that they may be considered sufficient treatment for an orchard. The improvement from the additional third and fourth treatments was very slight and was visible only at the close of the season.

(3) Pear leaf-blight on orchard trees in this section of Virginia does not commence its work early in the season, but is a late-appearing fungus. It develops on the foliage after the leaves are quite mature and continues to multiply after August 1. The attacks of fungi which caused differences to appear between plats 2 to 8 came mostly after August 2, long after the spraying was done, thus indicating that it was the thoroughness with which the trees were covered or the amount of fungicide on them that was important rather than the time when it was applied.

(4) From the results it would seem that the first spraying should be postponed until late in the spring, in order to have the fungicide fresh on the leaves during the first attacks of the disease, but should be made early enough to get ahead of the fungus. The second treatment should be made just ahead of the principal attack of the fungus and late enough so as to last well through the season. A leaf thoroughly sprayed once as late as June seemed to be protected for the rest of the season. The disadvantage of the early treatment is apparently due to the long exposure of the fungicide to the weather before the critical time.

(5) These results indicate that for Virginia the first treatment should be made between May 15 and June 1 or even on the latter date, and for regions farther north at correspondingly later dates; or to state the proposition in general terms, the first spraying should be given from four to six weeks after the trees blossom, and the second treatment should be made one month later.

The question naturally arises whether these results can be relied upon without repetition during a series of years. Of course one would feel much safer if they were repeated at least one season. Pear leaf-blight, however, is well known to be a very regular disease, both as to prevalence and severity, and exceptionally uniform during different seasons. This constant character of the disease makes the conclusions more safer than they would be with almost any other fungous disease.

It may be well to state that these conclusions do not apply to nursery stock or to trees which for any reason make a new growth late in the season. In another part of the orchard in question a block of trees which had been pruned back severely to renew the whole top was sprayed four times, the last treatment being on June 30. These trees made 3 to 5 feet of growth and at the close of the season the last 6 or 8 inches of the more vigorous shoots, which had doubtless grown after the last treatment, were either defoliated or spotted with leaf-blight. From this it is evident that trees putting out new growth require additional sprayings to protect the new leaves as they appear.

TREATMENT OF THE ORCHARD AS A WHOLE.

The orchard as a whole was sprayed with the same strength of Bordeaux mixture as the experimental plats, i. e., the 50-gallon formula. In making the mixture a method of preparing and using a stock solution of copper sulphate was devised, which saved the time required to weigh out and dissolve the copper salt for each separate quantity of the mixture. At the suggestion of the writer the plan has since been tried in New Jersey and New York, and has proved to be a great saving of time where a large amount of spraying is to be done. A barrel holding 50 gallons should be selected and 100 pounds of copper sulphate (large crystals can be used) suspended in a basket or a piece of coarse sacking in the upper part of it. The barrel is then filled with water. In the course of a day or two all the copper will be dissolved. The basket is then removed and more water is added until the barrel is again full. This second addition of water is necessary to fill the space which was occupied by the copper before it was dissolved. Each gallon of this solution will contain 2 pounds of the copper salt. If the copper salt is placed in the bottom of the barrel, it will be dissolved only with difficulty. It should be noted that considerably less than 50 gallons of water is added, owing to the fact that the copper occupies some of the space, but that the final solution of copper sulphate and

water makes the 50 gallons. If a greater or less amount of stock solution is to be made up, the vessel must first be measured and a mark made to indicate the required amount, and then the solution made up to this mark. For example, if 40 pounds of copper is desired in stock solution, do not add 20 gallons of water to it, because the resulting solution would then contain more than 20 gallons, but instead make a 20-gallon measure on some convenient vessel and make the solution up to the 20-gallon mark.

The lime may also be kept ready mixed for use. It should be slaked and run off as a paste, and should then be stored in barrels buried in the ground. A tight barrel should be placed beside the copper sulphate barrel and filled about one-fourth full of the lime paste, and then water should be added until the barrel is nearly full.

In making up the Bordeaux mixture it is only necessary to draw off the required amount of copper solution and pour it into the tank while it is being filled with water. When the tank is nearly full add several pailfuls of the milk of lime, obtained by stirring the lime paste and water together, allowing it to settle a few seconds and then dipping it off. By using the yellow prussiate of potash test* it is easy to determine when sufficient lime has been added. The operator soon learns the correct color of the mixture, and this serves as a guide as to when to make the test. All the material which goes into the tank should be strained through a sieve. In the case in question a sieve was made by tacking a square foot of rather heavy brass wire netting, with meshes 20 to the inch, over the end of a funnel-shaped box.

The spraying outfit used was a 150-gallon hogshead, mounted on a wagon. In it was placed a No. 2 Nixon pump, supplied with two hose, each 24 feet long, and a 6-foot brass tube, with stopcock and Vermorel nozzle. One man drove and pumped while two men directed the spray. As they passed between the rows each man sprayed one side of a row. The brass tubes enabled them to cover the trees thoroughly from the ground, except the tops of a few of the tallest. The nozzles gave a fine, misty spray. The endeavor was to touch every part of the tree with the spray, but only for an instant. It was generally necessary to stop the team a few seconds at a few of the trees, but the greater part of the work was done while the team was moving slowly along. If the trees had been small they could have been covered without stopping. Two outfits as described above were used in the work, and it took twelve days to go over the entire orchard once. It was sprayed four times, the cost of the whole work† being about as follows:

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*This test is simply the addition of a few drops of a solution of ferrocyanide of potassium. This solution is made by dissolving one-half ounce of the substance in 2 or 3 ounces of water, and if on the addition of a few drops to the Bordeaux mixture a brownish color appears, more lime should be added.

† The entire expense of the work herein described was borne by the Old Dominion Fruit Company.

1 white man, at $1.25 per day, 48 days	[illegible]
5 colored men, at 75 cents per day, 48 days	[illegible]
2 teams, with wagons, at $2 each per day, 48 days	[illegible]
Total labor	[illegible]
Chemicals	[illegible]
Wear and tear on sprayers	[illegible]
Grand total	[illegible]

It will be seen from the foregoing that the cost of treating one tree four times (estimating 16,000 trees) was 3 cents and 2 mills, the cost of treating one tree once was 8 mills, and the cost of treating one acre (estimating 203 acres) was $2.56.

It is undoubtedly true that the four treatments were more than were necessary, and that two sprayings well done would be all that could be desired, as shown by the experimental plats. In other words, had the facts brought out by the experiment been known at the beginning, the cost of spraying the orchard could have been reduced one-half.

It is important to notice that the principal cost was the labor in applying the mixture, the men and teams costing more than four-fifths of the total amount. The cost of the fungicide and apparatus was a relatively small matter. This suggests that future experiments should be directed toward improving the means of distributing the fungicide, and thereby reducing the amount of labor required.

DESCRIPTION OF PLATES.

PLATE XXXII.—Bartlett pear tree sprayed with Bordeaux mixture.
PLATE XXXIII.—Bartlett pear tree untreated and defoliated by leaf-blight.

EXPERIMENTS WITH FUNGICIDES TO PREVENT LEAF-BLIGHT OF NURSERY STOCK.

By D. G. FAIRCHILD.

The following paper gives details of experiments carried on at Geneva, N. Y., to prevent leaf-blight of pear and other seedlings. An abstract of the work has already been published,* but in this paper there will be given in detail the various formulæ used, with notes upon chemical reactions and upon the effects of the different substances employed.

EXPERIMENTS WITH PEAR SEEDLINGS.

The experiment with pear seedlings was carried on in coöperation with Prof. S. A. Beach, botanist of the New York State Experiment Station. I wish here to express my thanks to him for his careful attention to the planting and cultivation of the seedlings, for his assistance in their treatment, and for his valuable aid in taking notes upon the results.

* Report of Sec. of Agr. for 1892, pp. 224–229.

Bartlett Pear Tree Sprayed with Bordeaux Mixture.

BARTLETT PEAR TREE UNTREATED AND DEFOLIATED BY LEAF-BLIGHT.

The experimental block was situated only a few feet south of the main ursery experiment described in a previous paper.* All rows ran north nd south, at right angles to the rows of the main experiment. Each ›w was 20 feet long and at first consisted of about 250 small seedlings, ut these were thinned out until only from 130 to 150 remained.

The seed for the experiment was received, through the kindness of [r. S. D. Willard, from Vilmorin, Andrieux & Co., of Paris, in Febru-ry, 1891. It was imported mixed with moist sand and kept in the e house until April 20, 1892, when it was sown in shallow furrows, 4 ıches wide by 2 inches deep, and covered with earth. Over the earth thin layer of muck was spread.

The fall previous the ground had been sown to rye, which was plowed nder in the spring, before planting the seeds. The land had been ccupied by potatoes the year before, but no fertilizers had been applied › it. Hence the soil was not in the highest state of fertility, and it is ot surprising that in a part of the field only a feeble growth was made y the seedlings. The usual methods of cultivation were employed.

The arrangement of the rows was somewhat irregular, but this was rought about in the attempt to separate all rows receiving like prep-rations by as much ground as possible. This method of treating uplicate rows has many advantages, and in fact should be considered s essential to the settlement of problems like the one here involved.

A spraying apparatus of my own contrivance was employed, consist-ıg of a small Johnson hand force-pump fastened into a papier mâché ail by means of a thumbscrew. When many mixtures are to be em-loyed this apparatus has several advantages over the knapsack pump, he principal one being the ease with which it can be cleaned. With everal feet of hose, rows of considerable length can be very effectually prayed. The Vermorel nozzle with a lance was employed.

In spraying care was taken that every leaf should be touched. The eriods elapsing between the treatments were not long enough, it is elieved, to allow the best mixtures to be washed off. In one or two ases it was found that the untreated adjacent rows had received ccasional sprayings and it may be possible that an imperceptible mist ras blown upon the control rows oftener than was observable, these eing only 3 feet apart. It is believed, however, that this treatment f controls was so slight as not to vitiate the results in any way. The ıse of screens, made of light cloth or paper, to protect the control ows during treatment, would obviate any such difficulty.

The writer wishes to express his thanks to Messrs. W. T. Swingle ınd P. H. Dorsett, who assisted him very materially by suggestions ınd advice in the preparation of the fungicides. The preparations de-scribed below were, so far as my knowledge goes, first prepared by the parties above named. Those not mentioned were of my own invention or

* Jour. of Mycol., vol. VII, pp. 240–264.

had been previously employed by others. Nos. 2, 18, 19, 20, 21, and 2[illegible] were first prepared by Mr. Galloway and Mr. Swingle in experiments with wheat rust at Garrett Park, Md.

As it seemed advisable to adopt some arbitrary standard with which a comparison of the different substances could be made, it was decided to take as a standard the proportion of one part by weight of the metal forming the base of the salt to 1,000 parts of water. In the copper preparations it is 1:1,000; in the iron and zinc compounds, 2:1,000. It must not be supposed, however, that these are in all cases chemically accurate, since the substances used were not chemically pure and the water was not distilled. The same conditions prevailing, however, in each preparation it is thought that the comparative strengths are the same. One gallon of water was calculated to weigh 3,783 grams, and 3.78 grams of copper or 7.56 grams of zinc or iron, generally in the form of a sulphate, were used in the preparation of the mixtures. The proportion of the atomic to molecular weight gave the required weight of the salt to be used. In the preparation of the fungicides another point was kept constantly in view, viz, that no substance not in the finest possible state of division should be sprayed upon the seedlings. In order to secure the chemicals in this condition it was necessary to prepare precipitates and apply them before they became dry.

It has been found that dry, insoluble copper compounds, like cupric carbonate, when mixed with water do not split up into their smallest components, and hence do not adhere to the foliage as tenaciously as freshly prepared precipitates of the same substances. As will be inferred from the above, the preparation of each chemical necessitated the use of two or more ingredients, one the salt of the metal and the other an alkaline salt. With four exceptions the substances were all insoluble compounds, and by numerous titrations the optimum proportion of the salt containing the metal to that containing the alkali was established. By optimum is here meant that proportion which gave the lightest and most flocculent precipitate. Of two precipitates of the same salt, other things being equal, that one which remains longest suspended in the water is, according to the writer's idea, best suited for a fungicide. A rapidly settling fungicide is to be avoided if possible.

A test with potassium ferrocyanide was made to ascertain if any cupric sulphate remained in solution. As explained subsequently, there was present in all the mixtures a soluble salt, resulting from the combination of the alkali with the acid of the metal salt. This is indicated by the notes given after the name of the fungicide.

The plan of the experiment was made as simple as possible. Twenty-five substances mixed in water were applied to 50 rows of seedlings, that is, each substance was applied to 2 rows. These rows did not stand side by side, but were separated by at least 60 feet. On each side of every treated row stood an untreated one to serve for compari-

son. Thus 102 rows were planted, 51 standing south of a 5-foot alley, and 51 north. Every other row in the south block was treated, beginning with the second row. Each treatment made on the south block was duplicated upon the north block, rows treated with the same substances being placed as far apart as possible, in no case nearer than 50 feet. All rows were planted with seed from the same lot and as nearly as possible in the same manner. They were given precisely the same normal nursery treatment, being thinned out, hoed, and cultivated as nearly as possible on the same days. The seeds germinated normally and produced "stands" of uniform vigor, and not until the influence of the soil began to make itself felt was there the slightest difference noticeable between any of the rows. The unevenness of the soil, however, soon disturbed this uniformity and proved a more potent factor than the disease, but owing to the arrangement of the rows in duplicate it in no way disturbed the experiment.

The twenty-five chemicals which it was designed to test were all carefully weighed out, and concentrated solutions were prepared during the winter of 1891–'92 in the Department and shipped to Geneva ready to be diluted and applied to the seedlings with a sprayer.

The test of the preparations must be considered as wholly preliminary and designed to form a basis for further investigations. Hence the fact that a large number of the substances failed to prevent the disease by no means signifies that they may not yet prove to be true fungicides when of a suitable strength. According to the writer's notion, there is one requisite for, and two main limitations to, the preparation of a valuable fungicide. The requisite is that the preparation be a true fungicide and prevent infection from the disease. The limitations are, (1) that the expense of the material and its application, including the element of danger, shall not be greater than the benefit will warrant; and (2) that the effect upon the plant to be protected shall not be injurious. Any substance which fulfils the above requirements and does not overstep the limitations will prove a valuable fungicide.

Before it is possible to thoroughly test preparations with regard to the limitations above mentioned, it is necessary to gain some idea as to what mixtures are likely to be available for use and to eliminate those which from a combination of injurious and nonfungicidal properties are manifestly unworthy of further trials. In the summary the various mixtures have been grouped into three classes, clearly showing which are likely to be valuable.

In designating the different mixtures the exact chemical name of the supposed active salt has been used wherever the composition of such is known, otherwise the less specific title has been given.

The following is a list of the substances used, with the formulæ for their preparation and a statement of their effect upon the seedlings. The term "mixture" is here used in its broadest sense, to include the

whole product of the chemical reaction which takes place when two or more salts in solution are added together. In the majority of cases the mixture was a solution of sodium or potassium sulphate, with an insoluble metallic salt, either copper, zinc, or iron. The remarks upon the effect of the different preparations are designed as an aid to those who may wish to make further trials with them.

In order to get more definite ideas as to the preventive effects of the various preparations, six grades were established. These were arbitrarily chosen as follows: Grade 1, in which were placed all rows in which the injury to the foliage amounted to from 1 to 15 per cent; grade 2, from 16 to 30 per cent; grade 3, from 31 to 50 per cent; grade 4, from 51 to 70 per cent; grade 5, from 71 to 85 per cent; grade 6, from 86 to 100 per cent. The grade in which each row was placed was decided on after a careful examination and comparison by Prof. Beach and myself. It is believed that the comparative injury done by the disease upon the different rows is for all practical purposes shown as faithfully in this way as it could have been if every seedling had been counted and its condition tabulated. The grading was done twice, once on September 2 and again on October 13.

Under the description of each preparation there is given a comparison of each treated row with the two adjacent untreated ones. In order to make a fair comparison the average of the two untreated rows was taken, and with this the treated row was compared.

Mixtures and solutions tested.—In the twenty-five mixtures described below, where not otherwise stated the ingredients were each dissolved separately in 1 quart of water and thoroughly mixed together. The mixture was then made up to 1 gallon, and 1 quart of this was applied to each row of 130–150 seedlings on each of the following dates: (1) June 3–5, (2) June 14 and 15, (3) July 6, (4) July 20, (5) August 1, (6) August 15.

No. 1.—BASIC CUPRIC ACETATE MIXTURE.

(Rows 1 and 1^1.)

11.90 grams of copper acetate (basic refined powder).

Wet up to a thick paste and allowed to stand 24 hours or more before mixing in 1 gallon of water.

Chemical notes.—This refined powder is evidently a tribasic acetate, and, according to Watts' Dictionary of Chemistry, new edition, vol. I, p. 10, has the formula $2CuO. CuA'_2 2aq. = 3CuO, Ac_2O, Ac_2O2aq. = 2(HO, CuA')Cu(OH)_2$. The basic acetate has been used previously (see Div. of Veg. Path. Bull. No. 3, pp. 11 and 65. Also Beucker, Georges. <Prog. Agr. et Vit., Dec. 7, 1890, pp. 510–516.)

Remarks.—This mixture is easier to prepare, covers the foliage as well, and adheres as well as ammoniacal solution. It proved more effective in retarding the progress of the disease and was not injurious. The treated rows were ½ and 2 grades better than adjacent untreated rows on September 2, and 1½ and 1 on October 13. (The number first mentioned, denoting superiority, refers to the original row (1); the second to the duplicate row (1^1).)

NO. 2.—COPPER BORATE MIXTURE.

(Rows 2 and 2[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).

16.39 grams sodium borate (borax) ($Na_2B_4O_7$, $10H_2O$).

1 gallon of water.

Chemical notes.—The borate has probably the formula $(Cu_2H)BO_3 + \frac{1}{2}$ aq., which being decomposed by the water becomes $CuBO_2$. $3CuHO + \frac{1}{2}$ aq. (see Watts' ctionary of Chemistry, old ed., 1863, p. 643). The substance was used as a dried ecipitate by Lodeman,* but it was first proposed in its present form by W. T. ingle and used for rust of wheat.† The reaction would be represented by the lowing formula: $CuSO_4, 5H_2O + Na_2B_4O_7, 10H_2O = CuB_4O_7 + Na_2SO_4 + 15H_2O$. It therefore sprayed upon the plant in the form of a copper borate and a sodium lphate.

Remarks.—This mixture is more difficult to prepare and does not cover the foliage well, but adheres better than ammoniacal solution. It proved more effective in arding the disease and was not injurious. The treated rows were 1 and 2 grades tter than adjacent untreated rows on September 2, and 2½ and 1 on October 13. It is e of the most promising mixtures as regards efficacy, and might be tried stronger.

NO. 3.—COPPER BASIC CARBONATE MIXTURE.

(Rows 3 and 3[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).

14.90 grams sodium carbonate ($Na_2CO_3 + 10H_2O$).

1 gallon of water.

Chemical notes.—This precipitate when first formed probably has the following rmula: $CuCO_3$, CuO_2H_2, H_2O, but it rapidly becomes $CuCO_3$, CuO_2H_2 (see Watts' ictionary 1888, p. 698). It is the mixture previously known as the "Masson" ixture and is identical with the first compound formed in the preparation of modi-d eau céleste. The reaction is expressed as follows: $CuSO_4, 5H_2O + Na_2CO_3, H_2O = CuCO_3 + Na_2SO_4 + 15H_2O$. The preparation, therefore, reaches the plant the form of a copper carbonate and a sodium sulphate combined.

Remarks.—This mixture is more difficult to prepare than the ammoniacal solution, ut it covers the foliage and adheres about as well. It proved more effective in tarding the progress of the disease and was not injurious. The treated rows were and 2 grades better than adjacent untreated rows on September 2, and 3 and 2 on ctober 13. It is one of the most promising of the new fungicides as regards efficacy nd should be tried stronger.

NO. 4.—AMMONIACAL COPPER CARBONATE SOLUTION.

(Rows 4 and 4[1].)

7.03 grams cupric basic carbonate (copper carbonate) ($2CuO$, $CO_2(OH)_2$).

50 c. c. of water.

150 c. c. of aqua ammonia, 26 per cent (stronger water of ammonia) (NH_4HO.)

1 gallon of water.

The carbonate is wet up in the small quantity of water to a thin paste, and after few minutes the ammonia is added and the solution thus formed made up to 1 gallon.

Chemical notes.—The reactions for this fungicide, which is the ammoniacal solution s ordinarily used, with the addition of more ammonia than common, have been pubished by F. D. Chester in the Journal of Mycology, vol. VI, p. 23. A large quantity of ammonia was found necessary to a *complete* solution of the carbonate, but it was highly injurious.

* Lodeman, E. G. N. Y. Cornell Agr. Exp. Sta., Bull. No. 35, pp. 327, 331.

† Jour. of Mycol., vol. VII, No. 3, May, 1893, p. 201.

Remarks.—This solution was taken as the standard with which the others were compared, although it injured the leaves and necessitated a dilution to 2 gal. The excess of ammonia necessary to dissolve the carbonate was probably the cause of the injury. The grading was not upon the injury, but only as regards the disease. The manner in which this solution spreads and adheres is well known and forms a basis for comparison. The treated rows were graded — 1 and 1, or no better than adjacent untreated rows, on September 2 and 5, and 1 better on October 13.

No. 5.—CUPRIC FERROCYANIDE MIXTURE.

(Rows 5 and 5[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).

22.35 grams potassium ferrocyanide (yellow prussiate of potash) K_4FeCy_6, $3H_2O$.

1 gallon of water.

Chemical notes.—A well-defined chemical compound, with the formula Cu_2FeCy_6, with possibly CuK ferrocyanide present (see Watts' Dictionary, *l. c.*, 1889, p. —). The reactions, however, were not obtainable. It is used ordinarily as a delicate test for the presence of Cu in solution. According to observations of Miss E. A. Southworth, spores of *Cladosporium fulvum* grow luxuriantly in drops of water containing this precipitate. The normal reaction would be as follows: $CuSO_4,5H_2O+K_4FeCy_6, 3H_2O=CuFeCy_6+K_2SO_4+8H_2O$. This would indicate that the substance sprayed upon the plants was a combination of copper ferrocyanide and potassium sulphate.

Remarks.—This fungicide is more difficult to prepare than ammonical solution but covers the foliage as well and adheres about as well. It proved scarcely more effective, but did not injure the foliage. The treated rows were 1 and 0 grades better than the adjacent untreated rows on September 2, and 1½ and 0 on October 13. Further tests are necessary with a stronger mixture to settle the fungicidal value of this preparation

No. 6.—CUPRIC HYDRATE, BLACK, MIXTURE.

(Rows 6 and 6[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).

14.90 grams potassium hydrate (KHO) (caustic potash).

1 gallon of water.

The cupric sulphate and the potassium hydrate in concentrated solutions were mixed and allowed to stand until the mixture became black. Then the whole was made up to 1 gallon.

Chemical notes.—According to Prescott and Johnson (Qualitative Chemical Analysis, 4th ed., 1891, pp. 86–87), the combination formed when $CuSO_4$ and KHO are allowed to stand in contact is represented by the formula $Cu_3O_2(OH)_2$ if the solutions are both concentrated and the KHO is added to saturation. The normal reaction of the two substances as given above will be $CuSO_4 5H_2O+2KHO=Cu(HO)_2+K_2SO_4+5H_2O$. In the substance sprayed upon the plant there is, therefore, a combination of copper hydroxide and potassium sulphate.

Remarks.—This mixture is more difficult to prepare and does not cover or adhere to the foliage so well as ammoniacal solution. It proved more effective in retarding the progress of the disease and did not injure the foliage. The treated rows were 1 and 1 grades better than adjacent untreated rows on September 2, and 2½ and 1 on October 13. It is a mixture possessing no particular merit, and is markedly inferior to the hydroxide Nos. 7 and 8, but should be tried stronger.

No. 7.—CUPRIC HYDROXIDE MIXTURE.

(Rows 7 and 7[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).

29.80 grams potassium hydrate (KHO).

1 gallon of water.

Prepared in the same way as No. 6, but applied before turning to the hydrate.

Chemical notes.—The original intention was to have the formula as follows: 14.90 grams cupric sulphate, 7.45 grams potassic hydrate, and 1 gallon of water, but by a mistake the KHO was double the amount of cupric sulphate instead of being only one-half the amount. The original would have formed a basic sulphate, since KHO when added short of saturation to $CuSO_4$, $5H_2O$ gives a basic sulphate (see Prescott and Johnson, *l. c.*, pp. 86–87). The chemical formula of the hydroxide would be $Cu(OH)_2$, and in addition to the hydroxide present in the mixture there would be potassium sulphate. The reaction is the same as for No. 6.

Remarks.—This mixture is scarcely more difficult to prepare, covers the foliage as well, and adheres about as well as ammoniacal solution. It proved markedly superior in retarding the progress of the disease, but injured the foliage slightly. The treated rows were 0 and 2 grades better than adjacent untreated rows on September 2, and 2 and 2 better on October 13. It is certainly worthy of further trial, and is markedly superior to the black hydrate No. 6.

NO. 8.—CUPRIC HYDROXIDE MIXTURE.

(Rows 8 and 8[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
26.82 grams potassium hydrate (KHO).
1 gallon of water.

Prepared exactly as No. 7.

Chemical notes.—This mixture, which was intended for the simple hydroxide, was, because of a mistake in using an increased amount of potassium hydrate instead of a diminished amount (26.83 grams instead of 8.27 grams), applied as a hydroxide, with a large excess of KHO. It differed from No. 6 only in not being allowed to stand and thus become a black hydrate and from No. 7 in having less KHO. The substances in the sprayed mixture were the same as in Nos. 6 and 7, and the reaction would be the same.

Remarks.—In ease of preparation and application and in adhesiveness this mixture is like No. 7. It proved superior to ammoniacal solution in retarding the disease, but injured the foliage slightly. The treated rows were 1½ and ½ grades better than the adjacent untreated rows on September 2, and 0 and 1½ on October 13. It is slightly inferior to No. 7, but superior to No. 6. It differs in composition in no essential way from No. 7, and the difference in result is probably not significant.

NO. 9.—TRICUPRIC ORTHOPHOSPHATE.

(Rows 9 and 9[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
26.07 grams sodium phosphate (Na_2HPO_4, $12H_2O$).
1 gallon of water.

Chemical notes.—The pearly blue precipitate thus formed is in all probability the tricupric salt mentioned in Watts' Dictionary, 1866, p. 560, and having the formula $Cu_3P_2O_8$. No excess of $CuSO_4$ was observable in the supernatant fluid. The mixture as sprayed upon the plants was composed of copper orthophosphate and sodium sulphate. The reaction can be expressed as follows: $CuSO_4, 5H_2O + Na_2HPO_4, 12H_2O = CuHPO_4 + Na_2SO_4 + 17H_2O$.

Remarks.—This mixture is more difficult to prepare, but covers the foliage better and adheres better than the ammoniacal solution. It proved to have more efficiency in retarding the progress of the disease and did not injure the foliage. The treated rows were 1½ and ½ grades better than adjacent untreated rows on September 2, and 2½ and 0 on October 13. It is a mixture worthy of further trial.

NO. 10.—CUPRIC POLYSULPHIDE MIXTURE.

(Rows 10 and 10[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
14.90 grams potassium sulphide (K_2S_3 and K_2S_5 with intermediate forms) (liver of sulphur).
1 gallon of water.

Chemical notes.—Necessarily a more or less variable compound from the fa[illegible] the liver of sulphur is a variable factor, being composed of tri and penta sulph[illegible] with the intermediate forms. The most probable formula is $Cu_3S_2 + Cu_2S_3 +$ [illegible] or possibly a mixture of Cu_2S and Cu_2S_5 (see Watts, *Ibid.*, 1864, p. 76). Cupric su[illegible] phate seems to be present in slight excess, and from the reaction it is evident [illegible] this is combined in the solution with potassium sulphate.

Remarks.—This fungicide is only slightly more difficult to prepare, covers the fo[illegible] age about as well, and adheres better than the ammoniacal solution. It proved [illegible] rior to the ammoniacal solution in retarding the disease, and injured the folia[illegible] The treated rows were 1 and 1 grades better than the adjacent untreated rows [illegible] September 2, and 1 and 0 on October 13. Although much was hoped for from [illegible] mixture when first prepared, the experiment has not shown it to possess any re[illegible] able fungicidal value.

No. 11.—COPPER SUCRATE MIXTURE.

(Rows 11 and 11'.)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
14.90 grams cane sugar ($C_{12}H_{22}O_{11}$).
14.90 grams potassium hydrate (KHO).
1 gallon of water.

Cupric sulphate is dissolved in water and the cane sugar is added. The two are heated to boiling and then the potassium hydrate is added. All solutions [illegible] strongly concentrated.

Chemical notes.—This mixture proved troublesome to make, from the fact that [illegible] "sucrate" if heated too much after the addition of the potassium hydrate [illegible] bright red, turning to the red oxide. When properly prepared the mixture is a dark, livid green. The reactions are too complex to be written. Evidently l[illegible] is known of the exact composition of this peculiar compound, which differs entir[illegible] from that formed in the cold. It is not the "copper saccharate" of various Frenc[illegible] authors.

Remarks.—This mixture is much more difficult to prepare than ammoniacal solu[illegible] tion, does not cover foliage any better, and is more easily washed off. It prove[illegible] less effective in retarding the disease and injured the foliage slightly. The treate[illegible] rows were 0 and ½ grades better than adjacent untreated rows on September 2, and 1½ and 0 on October 13. It is so complex and difficult of preparation as not to warrant further trial.

No. 12.—COPPER SILICATE MIXTURE.

(Rows 12 and 12'.)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
44.70 grams sodium silicate (Na_4SiO_4 (?)) (Prescott and Johnson, *l. c.*, p. 215, water glass).
1 gallon of water.

Chemical notes.—According to the chemical catalogues, water glass is a pure sodi[illegible] silicate. No cupric sulphate could be detected in the supernatant fluid. It is a compound of which nothing definite seems to be known. It is not mentioned [illegible] Watts. The chemical reaction would be $2CuSO_4, 5H_2O + Na_4SiO_4 = Cu_2SiO_4 +$ [illegible] $(SO_4)_2, + 5H_2O$. According to this the compound sprayed upon the plants would be [illegible] mixture of copper silicate and sodium sulphate.

Remarks.—This mixture is slightly more difficult than ammoniacal solution to pre[illegible] pare, covers the foliage about as well, but does not adhere as well. It proved much less effective in retarding the progress of the disease, but was not injurious. The treated rows were 0 and 0 grades better than adjacent untreated rows on September 2, and ½ and ½ better on October 13. It merits further trial only in a more concen[illegible] trated form.

O. 13.—CUPRIC SULPHATE, AMMONIA, AND SOAP MIXTURE (SOAP EAU CÉLESTE).

(Rows 13 and 13[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
0.75 c. c. aqua ammonia 26 per cent (NH_4HO).
44.70 grams palm soap.
1 gallon of water.

The cupric sulphate was dissolved in water and the ammonia added to it. The soap :eviously dissolved in warm water was then added and the whole mixture churned ıtil a heavy foam was formed.

Chemical notes.—Palm soap was used as being the most available, but other kinds ' soap answer the purpose perfectly. This mixture is remarkable in its property ' spreading over the foliage. The waxy cuticle of the pear leaves in no way pre-ınts a complete coating from being formed. It is of indefinite composition and too ›mplex to be determined.

Remarks.—Although more difficult of preparation than ammoniacal solution, this ›vers the foliage and adheres to it in a manner unsurpassed by any mixture yet nployed, to my knowledge. It proved much more effective in retarding the progress f the disease and was not in the least injurious. It was tested upon the foliage of earing pear trees and showed remarkable efficacy in checking leaf-blight. It was lso used upon plum and horse-chestnut seedlings without the least injurious effect. pon grape foliage it proved somewhat injurious. The treated rows of pear seedlings 'ere 1½ and 1 grades better than adjacent untreated rows on September 2, and 2 and better on October 13. It is the most promising of all the 25 preparations employed. t is believed that the subject of soap mixtures is worthy of more extended investi-ation than it has hitherto received.

NO. 14.—CUPRIC OXYCHLORIDE MIXTURE (FORM A).

(Rows 14 and 14[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
29.80 grams chloride of lime ($CaOCl_2$)(?).
1 gallon of water.

Chemical notes.—A sooty black precipitate, often with a brownish tinge, formed ›est when both cupric sulphate and chloride of lime are in concentrated solution. 'he proportions of lime and sulphate are highly important. The addition of a small ›mount produces a green precipitate (No. 15), while the addition of a greater portion ›auses it to turn to a sooty black color on standing. Free chlorine seems to be given ›ff in the reaction. No cupric sulphate was detectable in the supernatant fluid. I vas not able to determine the composition of this compound and believe little is ›nown of it further than that it is probably an oxychloride.

Remarks.—This mixture is more difficult to prepare and apply than ammoniacal ›olution, spreads as well, but does not adhere nearly as well. It proved less effective n retarding the progress of the disease and was very injurious to the foliage, scorch-ng it severely and necessitating a dilution to 2 gallons. The treated rows were ½ ›nd 1½ grades better than untreated adjacent rows on September 2, and 0 and ½ better ›n October 13. It is a mixture with nothing to recommend it.

NO. 15.—CUPRIC OXYCHLORIDE MIXTURE (FORM B, TRIBASIC).

(Rows 15 and 15[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
21.28 grams chloride of lime ($CaOCl_2$) (?).
2 gallons of water.

Chemical notes.—This form of the oxide, according to Prescott and Johnson (*l. c.*), is known in commerce as "Brunswick green," and is used as a pigment. No cupric sulphate was in excess in the supernatant fluid. In Watts' Dictionary, edition of 1889, p. 260, it is stated that Brunswick green has the formula $CuCl_2$, $3CuO$, $4H_2O$.

Remarks.—This mixture is identical in method of preparation with No. 14, and

differs from it only in being slightly less injurious to the foliage. It was diluted to 2 gallons. The treated rows were 1½ grades better than adjacent untreated rows on September 2, and 1 and 1 better on October 13. The commercially prepared Brunswick green may not possess the injurious qualities to so high a degree as the freshly prepared precipitate and is worthy of a trial.

NO. 16.—COPPER SULPHITE MIXTURE.
(Rows 16 and 16[1].)

14.90 grams cupric sulphate ($CuSO_4, 5H_2O$).
37.25 grams sodium hyposulphite ($Na_2S_2O_3$, $5H_2O$) (U. S. Dispen., 15th ed., p. 1330).
1 gallon of water.

Chemical notes.—Cupric sulphate is in excess in the supernatant fluid. The precipitate settles rapidly, is of a dirty greenish-yellow color, and the proportions of the ingredients have little to do with the rapidity of subsidence of the precipitate. It is uncertain as to its composition.

Remarks.—This mixture, although scarcely more difficult to prepare than ammoniacal solution, covers the foliage no better, adheres no better, and proved very injurious, even after being diluted to 2 gallons. It was, however, more effective in retarding the progress of the disease. The treated rows were 1½ and 1½ grades better than adjacent untreated rows on September 2, and 0 and 2 better on October 13. It is doubtful if the mixture can be modified so as to fit it for use.

NO. 17.—FERRIC CHLORIDE AND PHENOL MIXTURE.
(Rows 17 and 17[1].)

36.46 grams ferric chloride ($Fe_2Cl_3 + H_2O$).
36.46 grams phenol (C_6H_5OH) (U. S. Dispen., p. 48) (carbolic acid).
1 gallon of water.

Chemical notes.—This forms a tar-black solution, emitting fumes of carbolic acid. The phenol used was of commercial strength, not crystallized, and equals 2 per cent of the crystallized. The perchloride of iron used has a formula of Fe_2Cl_6 according to Watts, 1865, p. 377, but the amount of water was not obtainable.

Remarks.—This mixture is slightly more difficult of preparation than ammoniacal solution, but extremely disagreeable to apply and highly injurious to the foliage. Dilution to 2 gallons seems to reduce the injury materially. In retarding the progress of the disease it proved less effective than ammoniacal solution. The treated rows were 1½ and 1½ grades better than untreated adjacent rows on September 2, and 0 and ½ better on October 13. It is a mixture altogether too obnoxious to warrant further trial.

NO. 18.—FERROUS FERROCYANIDE MIXTURE.
(Rows 18 and 18[1].)

22.94 grams ferrous sulphate exsiccatus ($FeSO_4$, H_2O).
45.88 grams potassium ferrocyanide ($K_4 FeCy_6$, $3H_2O$).
1 gallon of water.

Chemical notes.—A light marine-blue precipitate, which becomes dark Prussian blue on exposure to the air. The formula is probably Fe_2FeCy_6, with potassium ferrocyanide present (Watts, 1865, p. 334). The chemical reaction would be $Fe_2SO_4, H_2O + K_4FeCy_6, 3H_2O = Fe_2FeCy_6 + K_4(SO_4)_2 + 4H_2O$. The ferrous ferrocyanide is therefore combined in the mixture with potassium sulphate.

Remarks.—This mixture is considerably more difficult of preparation than ammoniacal solution, but covers the foliage as well and adheres with remarkable tenacity, far surpassing ammoniacal solution in this respect. It proved less effective in retarding the progress of the disease and was slightly injurious. The treated rows were 1 and ½ grades better than the adjacent untreated rows on September 2, and 2 and 2 better on October 13. It is a mixture seemingly possessing little fungicidal value.

No. 19.—IRON BORATE MIXTURE.

(Rows 19 and 19[1].)

22.94 grams ferrous sulphate exsiccatus ($FeSO_4$, H_2O).
91.76 grams sodium borate (borax) ($Na_2B_4O_7$, $10H_2O$).
1 gallon of water.

Chemical notes.—A steel-gray precipitate, becoming brown or yellow on exposure. Probably a basic salt of uncertain chemical composition (see Watts' Dictionary of Chemistry, 1888, p. 530). The chemical reaction would be written $FeSO_4, H_2O + Na_2B_4O_7, 10H_2O = FeB_4O_7 + Na_2SO_4 + 11H_2O$. The sodium sulphate is in combination with iron borate in the mixture as sprayed on the plants.

Remarks.—This mixture is much more difficult of preparation, covers the foliage no more effectively, and adheres no more tenaciously than ammoniacal solution. It proved almost entirely ineffective in retarding the spread of the disease and was highly injurious, scorching the leaves in a few minutes after application. The treated rows were 0 and ¼ grades better than adjacent untreated rows on September 2, and 0 and 0 better on October 13. It was the most injurious of any of the mixtures employed and has no good qualities to redeem it.

No. 20.—FERRIC HYDRATE MIXTURE.

(Rows 20 and 20[1].)

22.94 grams ferrous sulphate exsiccatus ($FeSO_4$, H_2O).
11.47 grams potassium hydrate (KHO).
1 gallon of water.

Chemical notes.—The precipitate is of a dirty green color, changing on exposure to a rich brown. The ferrous compound, $Fe(OH)_2$, which is formed on adding potassium hydrate to ferrous sulphate, becomes, on exposure to the air, the ferric compound, $Fe_2(OH)_6$ (see Watts). It is probable, however, that the green ferrous ferric compound was that first formed, as the air was not, of course, excluded from the mixture. The chemical reaction would be $FeSO_4, H_2O + 2KHO = Fe(HO)_2 + K_2SO_4 + H_2O$. The ferric hydrate and potassium sulphate are therefore in combination in the mixture.

Remarks.—This mixture is more difficult of preparation than ammoniacal solution, covers the foliage about as well, and adheres as well, but was slightly injurious. It proved much less effective in retarding the progress of the disease. The treated rows were 0 and ¼ grades better than untreated adjacent rows on September 2, and 0 and 0 on October 13. It is doubtful if this mixture has any fungicidal effect whatever.

No. 21.—IRON SULPHIDE MIXTURE.

(Rows 21 and 21[1].)

22.94 grams ferrous sulphate exsiccatus ($FeSO_4$, H_2O).
91.76 grams potassium sulphide (liver of sulphur, hepar sulphur).
1 gallon of water.

Chemical notes.—This mixture is in the form of an inky black fluid, which, on exposure, deposits an orange-yellow precipitate. When the proportion of potassium sulphide to ferrous sulphide is as low as three to one there is formed a precipitate in the liquid which gradually sinks to the bottom. Baric chloride gives the reaction for sulphuric acid in the solution. It is probably a compound of complex composition, as it is not described by Watts; possibly a potassium-iron sulphide (see Watts, 1872, p. 1077).

Remarks.—This mixture is more difficult to prepare than ammoniacal solution, covers the foliage no better, and adheres little if any better. It proved almost wholly ineffective in retarding the progress of the disease and was evidently slightly injurious to the foliage, although diluted to 2 gallons after the first application. The treated rows were 0 and ¼ grades better than adjacent untreated rows on September 2, and 0 and 0 on October 13. Its fungicidal properties, if any, are slight.

No. 22.—ZINC BORATE MIXTURE.

(Rows 22 and 22[1].)

33.36 grams zinc sulphate ($ZnSO_4$, $7H_2O$).

33.36 grams sodium borate (borax) ($Na_2B_4O_7$, $10H_2O$).

1 gallon of water.

Chemical notes.—A remarkably gelatinous precipitate of a milky white color. The above proportions are necessary, as a variation either way from equal parts gives a precipitate which settles very rapidly. It is a compound of very vague composition (see Watts' Dictionary, 1888, p. 530). The reaction would be written $ZnSO_4$, $7H_2O + Na_2B_4O_7$, $10H_2O = ZnB_4O_7 + Na_2SO_4 + 17H_2O$. A zinc borate and a sodium sulphate are in combination in the spraying mixture.

Remarks.—This mixture is much more difficult of preparation than ammoniacal solution, covers the foliage less completely, and adheres with about the same tenacity. It proved markedly inferior in retarding the progress of the disease and injured the foliage slightly. The treated rows were 1 and ½ grades better than adjacent untreated rows on September 2, and 0 and 0 better on October 13. A mixture with no qualities to recommend it for further trial.

No. 23.—ZINC FERROCYANIDE MIXTURE.

(Rows 23 and 23[1].)

33.36 grams zinc sulphate ($ZnSO_4$, $7H_2O$).

66.72 grams potassium ferrocyanide (yellow prussiate of potash).

1 gallon of water.

Chemical notes.—A yellowish white precipitate is formed by the reaction, settling very slowly. An increase of zinc sulphate causes a heavy precipitate to be formed, which sinks very rapidly. According to Watts' Dictionary, 1889, p. 337, the formula is Zn_2FeCy_6, $3H_2O$. The solution sprayed upon the plants contains in combination zinc ferrocyanide and potassium sulphate.

Remarks.—This mixture is much more difficult of preparation, covers the foliage no more effectively, and adheres with about the same tenacity as the ammoniacal solution. It proved wholly ineffective in retarding the progress of the disease and injured the foliage, necessitating a dilution to 2 gallons. The treated rows were 0 and 0 grades better than untreated adjacent rows on September 2, and 0 and 0 on October 13.

No. 24.—ZINC SILICATE MIXTURE.

(Rows 24 and 24[1].)

33.36 grams zinc sulphate ($ZnSO_4, 7H_2O$).

58.38 grams sodium silicate (water glass).

1 gallon of water.

Chemical notes.—An opalescent fluid with a precipitate which sinks very slowly. It is a compound of which little seems to be known. Watts does not include it. The chemical reaction would be written $ZnSO_4$, $7H_2O + Na_2SiO_4 = ZnSiO_4 + Na_2SO_4 + 7H_2O$. The mixture therefore contains zinc silicate and sodium sulphate in combination.

Remarks.—This mixture is more difficult of preparation, does not cover the foliage any better, and is less adherent than ammoniacal solution. It proved wholly without effect in retarding the progress of the disease and injured the foliage slightly. The treated rows were 0 and 0 grades better than adjacent untreated rows on September 2, and 0 and 0 on October 13.

No. 25.—ZINC SULPHIDE MIXTURE.

(Rows 25 and 25[1].)

33.36 grams zinc sulphate ($ZnSO_4, 7H_2O$).

66.60 grams potassium sulphide (liver of sulphur).

1 gallon of water.

Chemical notes.—A very fine greenish or yellowish white precipitate. Gives off odor of H_2S when potassium sulphide is added. The proportions were intended to be 1 to 2, but by a mistake 66.60 instead of 66.72, grams were used. Probably the compound is not clearly defined, as the liver of sulphur is a mixture of the trisulphides and pentasulphides, with intermediate forms, but without much doubt ZnS_5 is formed from the pentasulphide of potassium combining with the $ZnSO_4$.

Remarks.—This mixture is more difficult of preparation than ammoniacal solution and adheres to the foliage more tenaciously, but was slightly injurious and necessitated dilution to 2 gallons. It proved of scarcely any value in retarding the progress of the disease. The treated rows were 0 and 1½ grades better than adjacent untreated rows on September 2, and 0 and 0 better on October 13.

Summary.—While none of the above mixtures or solutions were really effective in preventing the leaf-blight, the retarding effect which several of them had upon the progress of the disease makes it seem probable that if their strength be increased they may prove valuable. The results of the year's experiments make possible the following classification, which will enable the investigator to choose for further experiment those mixtures worthy of trial:

(1) Mixtures which did not injure the foliage and retarded more or less the progress of the disease: Nos. 1, 2, 3, 5, 6, 9, 12, 13.

(2) Mixtures which injured the foliage, but retarded the progress of the disease: Nos. 4, 7, 8, 10, 11, 14, 15, 16, 17, 18, 22, 25.

(3) Mixtures which injured the foliage and did not retard the progress of the disease: Nos. 19, 20, 21, 23, 24.

As will be readily inferred, those mixtures under (3) are plainly excluded from further trial; those under (2) may possibly prove of value if sufficiently diluted, but since they only imperfectly retard the progress of the disease when strong, they are not likely to be effective when of sufficiently weak strength, while those under (1) are worthy of further trial in stronger proportions.

It should be remarked here, however, that these experiments were with pear seedlings only, and before making them applicable to other plants a trial will be necessary. This is plainly shown in the grape experiments with the same mixtures, in which many of the preparations that were not injurious to pear foliage proved injurious to the grape. The results of these experiments will appear elsewhere.

The writer is most forcibly impressed with the remarkable nature of Bordeaux mixture in this respect. Although the trials made by Smiths and Powell, of Syracuse, N. Y., with Bordeaux mixture upon seedlings were not satisfactory the present season, I am still of the opinion that had it been tried upon the experimental plat it would have shown itself superior to any of the other preparations employed. So far it seems to be the only preparation which gives to the foliage of treated plants an appearance of unusual health.

HORSE-CHESTNUT LEAF-BLIGHT.*

Horse-chestnut seedlings are subject to leaf-blight to such an extent that it has come to be looked upon by many nurserymen as something entirely normal to their growth—a natural ripening of the foliage. The disease first makes its appearance toward the latter part of June, and before the middle of August the leaves are generally entirely dead, often remaining attached to the seedlings until the middle of October or later. Although the damage done to the foliage of fully grown trees is not as serious in this northern climate as it is in the neighborhood of Washington, D. C., the young trees of two or three years' growth often have their foliage materially injured by the parasite. The principal growth of the horse chestnut being made very early, i. e., in the first six weeks, it is doubtful whether the loss to the plant is as great as in plants with a longer period of growth. The reserve material stored up must, however, be much less in defoliated stocks than in those maintaining healthy foliage throughout the season.

The experiments in the prevention of horse-chestnut leaf-blight were inaugurated in 1892, and only a preliminary report as to the effects of the fungicides is possible.

Two rows, comprising in all over one thousand seedlings, were under treatment. The seed was gathered from trees growing on the station grounds and planted in the fall of 1891 in shallow trenches. Nearly every seed germinated and an excellent "stand" was secured.

One row was divided into twenty-four sections, each containing twenty-five or more seedlings, and treated with the same mixtures as those described previously as being used on pear seedlings. Preparations Nos. 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, and 25 were used. Only alternate sections were treated, the intervening sections serving as controls. The dates of treatment were June 22, July 6 and 20, and August 1 and 15. At these dates the foliage of each section was thoroughly wetted with the preparation.

The disease first made its appearance the last week in June and spread very slowly over the experimental rows, injuring the foliage very irregularly. The sections, with two exceptions, seemed to be little benefited by the treatments. Preparations 14, 17, 18, 19, 21, 22, 24, and 25 injured the foliage to a greater or less degree. The injury manifested itself generally by a sickly yellow or brownish coloration of the foliage. On October 14 the only two preparations whose good effects were visible were Nos. 13 and 25. When every stock in these

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* *Phyllosticta sphæropsoidea* E. & E.

sections was placed in one of four grades as regards injury to the foliage the record stood as follows:

Treatment.	Number of seedlings.	Number in grade 1.	Number in grade 2.	Number in grade 3.	Number in grade 4.	Average grade.
Mixture No. 13	31	9	17	4	1	1.9
Control on No. 13	25	2	12	3	8	2.6
Mixture No. 25	26	0	20	4	2	2.3
Control on No. 25	31	0	11	9	11	3.0

The beneficial effects of the treatments with mixture No. 13 were plainly evident, and of the twelve mixtures employed this is the only one promising good results. The second row was divided into six sections, sections 1 and 2 being treated five and six times, respectively, with ammoniacal solution, and sections 4 and 6 on the same dates with Bordeaux mixture. The dates of treatment and the formulæ for the mixtures are given on a previous page, and were the same as those for the budded stocks treated in 1892. Sections 3 and 6 were intended to serve as controls, but unfortunately, by mistake, section 6 received one treatment on June 16 with Bordeaux mixture. The beneficial effect of the Bordeaux mixture was evident, as the disease spread upon the untreated sections, but the ammoniacal solution was plainly injurious to the foliage, the leaves which were treated with this assuming a faded brownish hue. In October the difference between the untreated stocks and those sprayed with Bordeaux mixture was marked. The former had lost many of their leaves and had few perfect ones, while the latter were provided with almost perfect foliage. No marked difference between five and six treatments was observable. The preventive effect of ammoniacal solution, while apparent, was, in the sections treated five and six times, inferior to that of Bordeaux mixture.

On October 15 the earth was removed from the base, and the seedlings of sections 3, 4, and 5 were calipered at the collar. The following data were thus obtained:

	Average caliper in $\frac{1}{32}$ of an inch.
74 seedlings untreated	12.8
57 seedlings treated 5 times with Bordeaux mixture	12.6
75 seedlings treated 6 times with Bordeaux mixture	12.6

As is shown, no difference in diameter of treated and untreated seedlings was observable. It is hoped that another year's observations upon the stocks may be made to ascertain the effect of maintaining the foliage upon plants like the horse chestnut, which make their principal growth before the disease defoliates them. This preliminary experiment, however, certainly warrants the recommendation of Bordeaux mixture as a preventive of horse-chestnut leaf-blight.

PRUNE RUST.

By Newton B. Pierce.

[Plates XXXIV-XXXVII.]

The prune, in common with many other drupaceous fruits, frequently has its leaves much injured or may be even entirely defoliated by a species of rust. This parasite belongs to the genus *Puccinia*, and is known as *Puccinia pruni* Pers. To Californians the effect of this disease on the prune, plum, and the peach is a very serious matter. The Pacific coast is known as the home of these fruits, and any widespread and detructive disease which affects them all should be well understood by horticulturists.

DISTRIBUTION AND ACTION ON THE STOCKS.

Prune rust is widely known, having almost as extended a distribution as the prune itself. It is found in the United States from the Atlantic to the Pacific, and the various countries of Europe are also quite generally infected. In the Eastern States it is most injurious to the plum and peach. In Texas the peach suffers severely from it, and in some sections is completely defoliated. In California the rust has a wide distribution. In the southern part of the State the injury is most serious in the coast valleys, where both the prune and peach are not unfrequently entirely stripped of their leaves before the wood is matured. Much fruit is lost both by the direct and the indirect action of the parasite. When the tree is defoliated before the fruit is mature the latter shrinks and becomes worthless; but the greatest loss generally occurs from the nonproductiveness of trees left with their wood immature in the fall.

As yet only two forms of spores are known for this species of *Puccinia*, the uredo or summer spore, and the teleuto or winter spore. These spores are produced in varying proportions on different plants. On some hosts the uredospores greatly predominate over the teleutospores, while on other hosts the reverse is true. It appears probable that conditions of food, humidity, climate, and season all tend to vary these results. Both spore forms are produced on the under side of the leaves, and probably both may, under some conditions, serve as winter spores.

The rust is known to affect the prune, plum, peach, nectarine, apricot, cherry, and almond. In California the prune sustains much greater injuries from rust during some seasons than others, depending largely on the early or late development of the disease. In 1891, at Santa Ana the rust developed early in some orchards, and much fruit was either lost or materially injured by the premature fall of the leaves. In 1892, in the same orchards, the disease developed later and with much less virulence. Where severe enough to defoliate the trees the defoliation did not occur until the fruit had been gathered and most of the wood

was properly ripened. Both the general and special effects of the disease vary according to the situation of the orchard, the age and variety of stock, the soil, etc.

When it attacks the prune the parasite causes the upper surface of the leaf to turn a yellowish or reddish color in irregular blotches, of greater or less extent, according as the points of attack are separate or confluent. The spores make their appearance in brownish or blackish patches on the under surface of the leaf, the brown patches usually being made up of uredospores and the black of teleutospores. The uredospores often appear earlier in the season than the teleutospores, the latter being normally developed as winter spores. Both kinds of spores are of good size and well formed. When the rust is abundant the tissue of the lower portion of the leaf is destroyed in such a manner as to present continuous, brown, lifeless areas. With the Tragedy prune, grown on the place of Mr. D. Edson Smith, of Santa Ana, the tissue of the under surface of the leaves was entirely destroyed, and was covered by an almost continuous and very dense layer of spores.

The action of the rust on the plum is similar to its action on the prune. In Texas it is stated that wild plums are attacked. Both uredospores and teleutospores are found, the latter often predominating.

Peach trees are frequently badly affected by this rust, and the trees of an entire orchard are sometimes defoliated. On the upper surface of the leaves the infected parts become yellowish or reddish in irregular and somewhat angular blotches, and on their under surface in separate or confluent, yellowish or brown, somewhat circular spots. The spores are mostly uredospores, although the teleutospores are often found, at least in California.* The fungus lives over winter on the tender twigs of the peach, frequently almost killing the young nursery stock. For this reason it would be well to spray the trees during the dormant season as well as after the growth has begun. For this winter treatment the following mixture is recommended: 5 pounds of copper sulphate, 10 pounds of lime, and 45 gallons of water.

The extra amount of lime causes the fungicide to adhere better than the usual amount of 5 pounds in ordinary Bordeaux mixture. It is not positively known if the same holds good with the prune and plum, although it is probable. Where rust is very bad upon either of these fruits the winter treatment is recommended.

On the nectarine the rust produces both uredospores and teleutospores, but, as with the peach, the uredospores greatly predominate.

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*In the Annual Report of the Commissioner of Agriculture for 1887, pp. 353-354, it is said that no teleutospores are developed on the peach. Although less abundant than the uredo form, they have invariably been found on badly infected peach leaves in southern California, and these leaves have been obtained from widely separated points in Los Angeles and Orange Counties, as at Florence, Santa Ana, Arch Beach, etc. They were fully matured by the middle of October.

The teleutospores are sometimes found in a semi-rudimentary condition. The spots are found on both surfaces of the leaf. The effects on the nectarine are similar to those on the peach.

In southern California the apricot is not commonly affected by rust to as great an extent as are the prune and peach, although usually the disease may be seen in nearly all orchards in the coast region. Sometimes the margin of the leaf is most affected, but all portions may be diseased. As in the previously mentioned cases, the uredospores predominate. The teleutospores are less abundant than upon the peach. The two forms when present are large and well developed. The rust produces on the apricot small, irregular, reddish, scar-like spots, which show on both surfaces of the leaf. The under surface finally turns a yellowish color and becomes powdery with the abundant uredospores. When badly diseased, the whole leaf may turn yellow and fall prematurely. As yet, however, I have not seen this tree entirely defoliated by the disease.

In the East the cherry is more or less injured by the same parasite, and I have no doubt that this is also the case for portions of the Pacific coast. As the cherry is neither extensively nor successfully grown in the warmer valleys of southern California, we have not had sufficient material for a general study. Farther north, and in the more elevated regions of the southern portion, where this fruit thrives, the parasite may be looked for.

The almond is infected by the rust to a limited degree. Both teleutospores and uredospores have been found, although the former were rare in the material examined. The teleutospores were rather small. The uredospores varied greatly in size and form, and in thickness of their walls. Some were dark and nearly spherical, while others were normal in form and thickness. So far as seen, the almond is not defoliated in California by the parasite.

TREATMENT.

The prune rust fungus is a truly endophytic parasite, vegetating and obtaining its nourishment wholly within the tissues of its host, and only appearing at the surface of the leaf for spore formation. This makes it evident that the treatment for the disease should be preventive in its nature. The application of sprays or other treatment after the parasite is within the tissues of its host can not act remedially and can only serve to prevent further infection.

The serious action of this parasite during the summer of 1891, and the fact that its attacks were more general and severe than in 1889, seemed to indicate that the disease was increasing, and it was decided to undertake a series of preventive experiments. This was the more necessary because the climatic conditions are very different in the coast valleys of southern California from those of the portions of the Eastern States

where most experimental work of this nature has been conducted. Methods applicable to the one region might be unsatisfactory in the other. It was desirable, also, that the work be done with the prune, which is not grown much in the East, and with which no experiments, as far as known, had been conducted. The line of treatment offering the greatest prospects of success was published by the writer early in the spring of 1892, so that those who desired might experiment in their own orchards.*

Portions of two prune orchards, in which the rust had developed to a marked extent in 1891 were selected for the experiment. The orchards were about 5 miles apart, one south of Santa Ana and the other east of Orange, Cal. The trees in one orchard were sprayed with modified eau céleste, while a portion of those in the other orchard were sprayed with modified eau céleste and a portion with ammoniacal copper carbonate. The number of treatments and time of application were varied with different lots of trees. Besides these, two other orchards in the vicinity of Santa Ana were sprayed by their owners, both gentlemen using the modified eau céleste according to the formula followed in our work. One of the orchards, belonging to Mr. Charles Leslie, is situated northwest of Santa Ana, on ground somewhat lower than that of any of the other orchards treated.

Fortunately for the growers, but unfortunately for our experiments, the rust did not develop as early, and was not as general nor as virulent in the season of 1892 as in 1891. The disease did develop, however, in the orchard of Mr. Leslie, though later than usual and with less virulence. Here a striking contrast was observed between the treated and untreated trees about the 1st of October, and we are now able to show the efficacy of the spray used and to give the details and necessary expense of application.

In relation to the application of sprays, it may be said that for young trees of small size and pruned low, the knapsack sprayer may sometimes be used to advantage. This is especially true of gardens and orchards of small extent. Treatment of small trees with a knapsack sprayer will require from one and one-half to three minutes per tree, according to size and state of development of the foilage. The tank of the sprayer holds about 4 gallons, and to avoid loss of time some convenient mode of refilling should be near at hand in the field. For trees 4 or 5 years old a cart sprayer holding one or two barrels of the spraying mixture is very convenient. Experiments were conducted with the "Little Giant" cart, holding slightly over a barrel. The tank is

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*See notes on "Fungous diseases and their treatment." <Proc. and Trans. of the Pomological Soc. of Southern California, Redlands, May 27 and 28, 1892, pp. 24–29; also, Rural Californian, June, 1892, pp. 303–305, and extracts in numerous other journals. The present season's work has shown that the disease may be controlled with fewer sprayings and at less expense than were thought necessary at the time these recommendations were made.

mounted on two large iron wheels, with a third and smaller wheel in front as a support. It is supplied with a good brass force pump capable of throwing two sprays. It may be drawn either by hand or by a horse directly attached, or it may be placed in a light one-horse wagon. The last arrangement raises the head of liquid, and enables the cart to be easily drawn in soft or plowed ground. A fair-sized orchard can be thus treated with little loss of time.

If the trees to be sprayed are large (6 years old or older), and especially if the orchard be extensive, it is well to have a special tank. The horizontal wooden tank, resembling a cylinder, but narrowed toward one end, is now considered by many the best pattern made, although somewhat more expensive than the rectangular box tanks. It is, however, much less liable to leak, and is especially suited to keeping its contents well stirred.*

From the fact that the rust fruits mostly on the under surface of the leaves, as well as from a study of the habits of other fungi in this region,† it appears probable that infection of the host occurs in most

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*For those who may desire to construct a tank of this description, measurements are given of the one owned and used by Mr. Leslie in his treated orchard. It is intended to rest on a platform placed upon the bolsters of a common lumber wagon, and supported and kept from rolling by transverse scantling made concave above. The length of the side of the tank is 9 feet 8 inches. Its diameter at the small head is 27 inches inside measure, and 31 inches outside measure. At the large end the inside diameter at the head is 31 inches, and the outside measure 35 inches. This diameter allows the tank to fit well between bolster stakes, which are 3 feet apart. The heads of the tank set back 3 inches from the ends of the staves. The staves are made of 2-inch dressed plank about 4½ inches wide at the broad end and narrowed toward the small end to about 4 inches, and are all beveled on the edge. Six bands of iron are used as hoops, which are $\frac{3}{16}$ by 2 inches. One is placed opposite each head and the other four at equal distances between them. This tank holds, approximately, 300 gallons, and by placing it so that its upper surface is level the tank may be completely filled; thus arranged, the last of the fluid it contains will flow to the large end, where all may be pumped out by the force pump situated there. The tank is filled through an opening 12 by 16 inches, supplied with cover and screen, located at the center of the tank. Near the bottom of the large head is a bung for cleaning out. The force pump is firmly fastened to the top and near the large end of the tank, and the suction pipe reaches nearly to the bottom. The pump should be strong, double-acting, furnished with large air chamber to insure an even flow, and is usually of the piston pattern. Brass fittings or a brass pump are preferable to those of iron. Arrangements should be made for dividing the discharge pipe by the attachment to its ends of separate lengths of hose. The hose should be of good quality and each piece should be about 25 feet long. Thus equipped, two trees may be sprayed on each side of the wagon before it is moved. The free end of each hose should be attached to a brass pipe 6 or 7 feet long, and carrying the nozzle at its extremity. Iron pipe corrodes too easily with the copper sulphate mixtures, and, being heavier, the work done with it is not apt to be as satisfactory.

†See observations on the habits of *Cercospora circumscissa* Sacc. in this Journal (vol. VII, No. 2, p. 69). This parasite is shown to affect almond branches to a much greater extent upon the lower than upon the upper surface. The more favorable conditions of humidity below the branch, there assigned as the partial cause, would apply equally well in the present case.

stances from the germination of spores on the under side the leaf. or this reason it is essential that the under surface receive the most orough treatment. In the experiments here described four nozzles re used, viz, the Climax, the San José, the Cyclone, and the Improved ermorel, and their adaptation to the work noted. They are all good zzles, but when used with eau céleste mixtures a serious defect is found all of them. The corrosive action of this spray, whether the latter be med according to the modified formula or not, destroys the brass tting of the Climax nozzle and the brass plate containing the slot of e San José. The action on the other nozzles is similar, but the brass ing thicker the openings enlarge less rapidly. The manufacturers of e Climax nozzles state their intention to supply aluminium nets for em, which will probably withstand the spray. This is a more import matter than it at first appears, and is especially so to Californians. California fewer applications of fungicides are required than in the ast, because of the partial absence of summer rains along the south n Pacific coast, but these applications should be more thorough. To operly spray a tree with one or two applications the spray must be ne, uniform, and carefully applied. To form this spray the nozzles ed must be in good condition, which is not true when the openings e enlarged; in this case the liquid falls on the foliage in coarse drops, hich run together and dry. When large areas are thus wetted the uid will often "creep" or "crawl" when drying, as paints do when ater is accidentally mixed with the oil. In this way the copper salts e brought together and dried in a few large areas instead of being stributed over the leaf in small drops which dry where they fall. ith enlarged openings in the nozzle much of the leaf is therefore left ithout the protection of the fungicide, while with the fine spray the umerous collections of dried copper are distributed by the humidity the atmosphere or dews and fogs to all parts of the leaf surface. o those who have applied the resin washes to citrous trees it will e apparent that the mode of applying sprays for fungi is quite differ nt from that followed for scale insects. For the latter an effort is ften made to uniformly coat the branches and foliage with the mix re, as the nature of the spray used will allow of this even when the arts are completely wetted. With the copper washes, however, the arts should be finely sprayed and not overwetted if the attacks of ngi are to be prevented in the most satisfactory manner. Foliage hus overwetted by almost any of the copper sprays, and especially by au céleste, is apt to be more or less burned. Prune trees have been ntirely defoliated where the spray was too coarse.

If the San José or Climax nozzle be used, the perforated plates and rass-wire screens should be replaced as soon as corroded. With the yclone nozzle no arrangement is found for a renewal of the corroded arts. Hence this nozzle, to be satisfactory, should be made of noncor osive metal. It presents one very desirable feature, viz., the spray is

thrown out laterally. Where the spray is thrown directly ahead of the workman, especially if small trees are being treated, or if there is a wind, much of the spray passes beyond the tree. Besides this, the under surface of the foliage is not so perfectly sprayed as it could be by the use of a nozzle throwing a lateral spray upward toward the under surface of the leaves, or downward upon their upper surface. The application is thus made directly to the leaf surface to be treated and little loss of material or time is sustained. With those having a large number of trees to spray, this saving is of prime importance. There should always be a swivel in the pipe to which the nozzle is attached. This allows the easy turning of the pipe while spraying the interior of the top of the tree, and the spray is sent in all directions without withdrawing the pipe. Where it is not absolutely necessary to use eau céleste, corrosion of the nozzles will be avoided by the use of ammoniacal copper carbonate. This spray, besides being nearly or quite as effective as the modified eau céleste and lacking the corrosive action on nozzles and other metallic fittings, has the advantage of not showing to an obvious extent upon the treated fruit. The eau céleste is often discernible upon the prunes at the time they are gathered.

The following are the formulæ for making ammoniacal copper carbonate and modified eau céleste;

Ammoniacal copper carbonate.—In a wooden pail place 5 ounces of copper carbonate; soften the carbonate to a paste by the addition of a little water, add 3 pints of strong ammonia (26°), and stir until the carbonate is dissolved. If it will not wholly dissolve add sufficient ammonia to accomplish that result. Pour into a barrel holding 45 or 50 gallons and fill the barrel with water.

Modified eau céleste.—Dissolve 4 pounds of copper sulphate in a wooden vessel containing 10 or 12 gallons of water, and afterwards stir in 5 pounds of sal soda. When the soda is dissolved pour in 3 pints of strong ammonia (26°) and dilute to 45 gallons with water.

As already indicated, the Leslie orchard, which was sprayed with modified eau céleste, presented the most evident beneficial results seen in any of the orchards treated. This, it is believed, was not due to any superiority of eau céleste over ammoniacal copper carbonate, but to the early and more marked development of the disease in that orchard than in the others. It has been shown during the past summer, in a carefully conducted series of experiments in combating the shot-hole fungus of the almond (*Cercospora circumscissa*), that modified eau céleste and ammoniacal copper carbonate possess almost exactly equivalent value as fungicides. This being true, there are several reasons why the amoniacal copper carbonate is to be preferred for this work: (1) It costs much less than the other spray; (2) it is less liable to injure the foliage, and does not seriously affect the nozzles and other metal appliances used in spraying; (3) spotting of the fruit and foliage is much less distinct than that caused by modified eau céleste; (4) it is easier to prepare.

The cost of the ammoniacal copper carbonate will vary in different portions of the country. The wholesale price of copper carbonate in the Eastern cities is about 40 cents per pound. To this about 3 cents should be added for freight to the Pacific coast, making the cost 43 cents per pound in California. Ammonia (26°) can be had at 8 cents per pound in the East, and should not exceed 10 cents per pound in California. At these prices the cost of the ammoniacal copper carbonate solution, made according to the above formula, would be $1 per 100 gallons. This cost may be reduced by making the copper carbonate at home from sulphate of copper and sal soda, as follows:

To make copper carbonate.—Dissolve in a large wooden tub 6 pounds of copper sulphate in hot water. In another wooden vessel dissolve 7 pounds of sal soda in hot water. When both solutions are cool pour the soda solution into the copper solution and fill the tub with water. Unite these mixtures slowly or they will overflow. Stir thoroughly after the water is added and allow the solution to stand twenty-four hours; then draw off all the clear liquid with a siphon. Fill the tub with water, stir, and again allow it to stand twenty-four hours and settle, and then draw off the liquid as before. Dry the substance remaining, which is mostly carbonate of copper. When dry it should be a light green powder. The sediment may be dried in an earthen jar kept in a kettle of boiling water or in the sun.

If the sulphate of copper and sal soda are of good quality, which may be told by the deep blue of the former and the transparency of the latter,* the quantity given in the above formula should make 2½ pounds of the carbonate.

The average wholesale price of copper sulphate in the East is 6 cents per pound and that of sal soda 1½ cents. The Santa Fe Railroad Company has quoted freight rates on these chemicals from Chicago to Santa Ana at 1½ cents. This makes the cost of copper sulphate on the Pacific coast 7½ cents and of sal soda 3 cents per pound. At these rates 6 pounds of copper sulphate aud 7 pounds of sal soda would cost 66 cents; and as this quantity makes 2½ pounds of the carbonate, the cost per pound of this chemical, when made at home, is 26 cents. For 45 gallons of spray, according to the above formula, there would be used 5 ounces of carbonate, worth 8 cents, and 3 pints of ammonia, worth 30 cents, a cost of 80 cents for 100 gallons, or a saving of 20 cents per 100 gallons by the home manufacture of the carbonate. At the above prices for copper sulphate, sal soda, and ammonia, when used to make modified eau céleste, 45 gallons would cost 75 cents, or $1.66 per 100 gallons.

The amount saved by using the ammoniacal copper carbonate instead of the modified eau céleste is worth considering where a large orchard is to be sprayed. With the other advantages already enumerated, the

* Air-slaked sal soda or pale blue sulphate of copper should never be used in any spray work. If the former be used in making copper carbonate, a magma will be formed when the two mixtures are united, which will prevent the satisfactory completion of the process; and if it be used in making the modified eau céleste the acid of the spray will remain so strong as to burn the foliage.

former spray becomes much more desirable than the latter for work.

The cost of spraying an orchard depends upon the size of the tree, the state of development of the foliage, the presence or absence of w[ind] when the sprays are applied, the fineness of the spray used, the thoroughness of the work, and the cost of labor and material.

About 350 prune trees 5 years old were sprayed in the Leslie orchard with 600 gallons of modified eau céleste, the application of which required three men and a team for thirteen hours. In this work the San José nozzle was used. The corrosive action of the spray injured the plates of the nozzles so that more of the solution was used than was required to do the work. The direct throw of the spray added to this loss and the loss of time was proportionate. From carefully kept records of my own experimental work, it appears that at least 25 per cent more material and time was consumed in this orchard than was needed if the work had been done with ammoniacal copper carbonate applied with a lateral nozzle. This would reduce the spray needed to 450 gallons, and the time for applying to about ten hours. The cost of 450 gallons of ammoniacal copper carbonate at $1 per 100 gallons is $4.50. Estimating the cost of a man and team at $3 per day, and of 2 men for applying the spray at $1.50 each per day, the cost of applying the spray would be $6 for ten hours, or 60 cents per hour. At this rate the total cost is $10.50 for 350 trees, or an average of 3 cents per tree for a single spraying. This is not an underestimate, where the chemicals are purchased at wholesale prices and properly applied. The expense of spraying large trees will be increased in proportion to the increase in size.

The number of treatments necessary to prevent the injurious effects of the parasite varies from season to season. In the East the treatments should be more numerous and at shorter intervals than in California. At present it is believed that in southern California two thorough sprayings of the prune tree will sufficiently keep the parasite under control. Although no rigid rule can be given as to dates, it is probable from the past season's work that the first treatment may be safely made about the time the trees cease to bloom, and when the old wood is in nearly full leaf. A second spraying should be made after a fair amount of new wood and foliage has been formed. When these two treatments are carefully and thoroughly made, say about the 1st of May and again about the 1st of June, varying according to conditions, it will rarely be found necessary to treat the trees a third time, unless the orchard be situated in a low and damp region. In this case a third spraying may be given two to three weeks after the second.

The dry summers of California allow the spray to remain on the foliage until the fall rains, that is, in cases where the applications are made after the last spring rains. In the Santa Ana Valley trees sprayed in May clearly showed the copper on their leaves as late as the last of October.

PRUNE ORCHARD TREATED FOR RUST.

Prune Orchard Untreated and Defoliated by Rust Fungus.

Treated Prune Tree 5 Years Old.

UNTREATED PRUNE TREE 7 YEARS OLD.

DESCRIPTION OF PLATES.

PLATE XXXIV.—Leslie prune orchard, 7 years old, grown on a rich, deep, fine sedimentary soil; situated about 2 miles northwest of Santa Ana, Cal.; affected by rust in 1891 and again in 1892. It was sprayed with modified eau céleste during the first half of June, 1892, receiving one treatment during the season. This treatment was sufficient to cause the trees to retain their foliage, to the extent shown, unt.l October 4, when the photograph was taken. Compare with Plate XXXV, which shows the untreated half of the same orchard.

PLATE XXXV.—Unsprayed half of the prune orchard represented in Plate XXXIV. The trees were defoliated through the action of rust. Photographed October 3.

PLATE XXXVI.—Prune tree 5 years old, treated about the 1st of June, 1892, with modified eau céleste. This tree was in an orchard affected by the rust, and should be compared with the tree shown in Plate XXXVII. Photographed October 3, 1892.

PLATE XXXVII.—Prune tree 7 years old and wholly defoliated by rust. Had been bare some time before the photograph was taken on October 3, 1892. Compare with Plates XXXIV and XXXVI.

PRELIMINARY NOTICE OF A FUNGOUS PARASITE ON ALEYRODES CITRI R. & H.

By H. J. WEBBER.

In the course of some investigations on "sooty mold,"* a fungous disease of the orange and other citrous fruits, it was soon learned that in order to successfully combat the fungus means must first be found to remove the insect pests, which evidently induce the disease. In Florida the "sooty mold" is principally nourished by the honeydew excreted by *Aleyrodes citri* (the so-called "white fly") and certain waxy scale insects and aphids; however, it becomes serious only as it follows *Aleyrodes citri*. In view of these facts, experiments have been conducted for the purpose of determining the most effective means of combating *Aleyrodes*. Attempts have been made to discover insect enemies of *Aleyrodes citri* which would aid in keeping the pest in check, but to my knowledge no such parasite has been discovered. In this state of our knowledge, I am fortunately able to announce the discovery of a fungus which is parasitic on the larvæ and pupæ of *Aleyrodes citri*, and which may prove useful in fighting the insect.

While walking through the orange grove of Mr. J. H. Harp, of Crescent City, Fla., in August, 1893, some leaves infested with the larvæ and pupæ of *Aleyrodes citri* were collected. Mixed with the insects on the same leaves the orange-red pustules of a fungus were found, but nothing was thought of the significance of the discovery at the time. In January, 1894, I visited the orange grove of Mr. W. B. Varn, at Bartow, Fla., and again found the same fungus in considerable abundance. A more careful examination of this material led to the conclusion that the fungus was probably a parasite on the larvæ and pupæ of *Aleyrodes*

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* *Capnodium citri* B. & Desm.

citri. Numerous groves where the fungus infests *Aleyrodes* have since been examined, particularly in the vicinity of Crescent City and Gainesville, Fla. The fungus has been provisionally identified as *Aschersonia tahitensis* Mont. It occurs in orange groves at Crescent City, Bartow, Panasoffkee, Gainesville, and Manatee. In the noted groves of Citra, Fla., where some 300 acres of orange grove are literally black from the effects of "sooty mold" following *Aleyrodes*, no signs of *Aschersonia* have as yet been discovered. Many other groves in the State where *Aleyrodes citri* occurs still remain free from this friendly fungus.

Experiments have been started to spread *Aschersonia tahitensis* into uninfected groves, both by introducing small trees harboring affected *Aleyrodes citri* pupæ and also by artificial means.

In the town of Gainesville, where for a number of years *Aleyrodes citri* has been very abundant and destructive, the trees are now acknowledged by general accord to be much better than they have been since first attacked. An examination of the trees here shows *Aschersonia* to be very abundant. On many trees it is indeed difficult to find a living pupa of *Aleyrodes citri.* In such cases the lower surfaces of the leaves are thickly dotted with the orange-red pustules of *Aschersonia.*

When the parasitic fungus (*Aschersonia tahitensis*) has grown to maturity it is easily removed from the leaf, the switching of the leaves and branches resulting in the removal of many of the pustules. The bright green spots, where the surface of the leaf is thus revealed, surrounded by the black "sooty mold," are quite conspicuous.

The growth of *Aschersonia tahitensis* on the larvæ and pupæ of *Aleyrodes* causes the scale to noticeably enlarge. The hyphæ of *Aschersonia* burst out around the edge of the scale, forming a dense fringe. The mycelium gradually grows up over the scale and eventually entirely surrounds it, so that in the advanced stages of the fungus it is difficult to find the fragments of the *Aleyrodes* scale.

A species of *Aschersonia*, probably the same as that infesting *Aleyrodes citri*, has also been discovered at Gainesville, Fla., growing in considerable abundance on a waxy scale (*Lecanium*) of the sweet bay tree. This scale also secretes honeydew in considerable quantities and is followed by the "sooty mold."

In the present stage of the investigation it can not be positively stated whether the spread of *Aschersonia* will be rapid enough to materially check the ravages of *Aleyrodes citri*, but appearances point strongly to this conclusion. The matter is being investigated and will be reported upon later.

SUBTROPICAL LABORATORY,

Eustis, Fla.

AN IMPROVED METHOD OF MAKING BORDEAUX MIXTURE.

By W. T. Swingle.

Since the first of the year I have had under way rather extensive experiments with Bordeaux mixture to determine its effectiveness in preventing a fungous disease of the lemon known as scab. The necessity of making large quantities of the mixture soon showed how slow and inefficient the common methods for its preparation are. After a number of attempts a much quicker and at the same time better method was worked out, and it is the object of this paper to call attention to the method. It might be noted that the lemon proves to be exceedingly sensitive to slight changes in the composition of the mixture, and hence is a very good plant to use in determining the best form of this fungicide.

METHODS OF DISSOLVING THE COPPER SULPHATE.

Probably the best method of dissolving large quantities of copper sulphate without heat is that suggested by Mr. M. B. Waite in 1893 and described on page 336 of this number of the Journal. By this method it is a simple matter to prepare strong solutions containing as much as 2 pounds of copper sulphate to the gallon. Moreover, it is possible to use large crystals instead of the more expensive and more easily adulterated pulverized bluestone. Another method, still more expeditious and superior to the old way of pouring hot water on the bluestone and stirring it till it dissolves, is to conduct steam into the bottom of a barrel containing the copper sulphate and water. With a small supply of steam, especially if under considerable pressure, the water can be heated in an incredibly short time. Besides, the current of steam issuing from the pipe sets the water and crystals in violent motion and insures a frequent change of the water in contact with crystals. In all cases where the solution is effected with the aid of heat it should be allowed to cool before being used.*

STOCK SOLUTION OF COPPER SULPHATE.

As early as 1887 the French viticulturist Ricaud† published an account of a method of making a strong solution containing a known weight of copper sulphate to each liter. This makes what is commonly

* While working at the Kansas Experiment Station in 1890, Prof. W. A. Kellerman and myself found steam conducted through a small pipe fitted with a stopcock to be a most valuable means of keeping the temperature of the water at 132° F. for treating smut of oats and wheat (see Kellerman and Swingle, Kans. Agr. Exp. Sta. Bull. No. 12, Aug., 1890, p. 49; and Georgeson, Burtis, and Shelton, Kans. Agr. Exp. Sta. Bull. No. 29, Dec. 29, pp. 177–178). Mr. W. C. Hewitt, manager of the Sunset Orange Company, Stanton, Fla., tells me that he finds steam invaluable in making sodium sulphide, kerosene emulsion, and other sprays. This method of heating is unquestionably the best for all who have steam available, and should be generally used by such.

† Ricaud, J. Le traitement du mildiou, la dissolution cuivreuse comparée aux autres préparations liquides (Jour. d'Agr. Prat., 51e ann., t. I, No. 3, Jan. 20, 1887, p. 90).

known as a stock solution. In this country Mr. Waite has used this system with great success. His method is described on page 37[illegible] of this number of the Journal. The advantages of the system are obvious; the delay occasioned by having to dissolve small amounts at a time is avoided, since a large amount can be dissolved in advance and any required number of pounds can be quickly obtained by measuring out the proper number of gallons without any operation of weighing. If steam is used for dissolving the copper sulphate, exactly the same method may be adopted as when the substance is dissolved by suspension. When it is desired to have the solution ready for use in a few hours, and neither steam nor hot water is at hand, a stock solution containing only 1 pound to the gallon can readily be made.* In no case should the copper sulphate be dissolved or stored in an iron kettle or other metal receptacle, since the copper is thrown down and other sulphates formed. A case recently came to my notice where after prolonged boiling of the copper sulphate solution in an iron kettle, the copper was all thrown down in the form of metallic scales, and the liquid on testing proved to be almost pure iron sulphate in solution. The solution can be kept a few days or a few weeks in a wooden vessel without noticeable change, but probably can not be left indefinitely without a slight loss† of strength. The vessel should of course be kept covered to prevent evaporation and to keep out impurities.

SELECTING AND SLAKING THE LIME.

Only the best well-burnt fresh stone lime should be used in making Bordeaux mixture. All powder occurring in the barrel should be looked upon with suspicion, since it is very likely to be air-slaked and consequently worthless and even dangerous to use for this purpose. In slaking, some little care is required in order to get uniformly good results. If 50 or 100 pounds are to be slaked, the amount can be placed in a barrel or other water-tight vessel. A considerable supply of water should be at hand, so that the lime will not get too dry from taking up water faster than it can be supplied. At first water should be added slowly, stirring vigorously; it should be added just as fast as it is taken up by the lime. The lumps of lime should never be allowed to project into the air for more than a few seconds. The whole slaking mass must be most thoroughly stirred or the lower portions will not be wetted at all, the upper layers absorbing all the water. It will not do to have just enough water to cause the lumps to swell and fall to a

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* In this case instead of weighing out twice as many pounds as the barrel holds gallons, the same number of pounds are weighed out and suspended for solution. When all dissolved, the liquid is brought up to the required amount. This gives a solution containing 1 pound to the gallon.

† According to Clément, as quoted by Biedermann in Ladenburg, Handwörterbuch der Chemie, 6, 305, a solution of copper sulphate kept in a wooden vessel gradually deposits crystalline copper.

powder, since in this case the product is lumpy and makes a mixture of poor quality that clogs the nozzle badly. The milk of lime obtained should be of the consistency and have much the appearance of thick cream, and should be free from granules when felt between the fingers. In slaking a small amount of lime, such as 1 or 2 pounds, the mistake may easily be made of adding too much water and thus greatly retarding the action. In such cases it is best to use hot water, adding it little by little as it is absorbed. There is very seldom any difficulty in getting large amounts of lime to slake.

STOCK MILK OF LIME.

It has been found that the stock method, so valuable with copper sulphate, can be used with equal advantage for the lime. A barrel is taken, the capacity of which has previously been carefully determined, and twice as many pounds of stone lime are placed in it as it holds gallons. The lime is then slaked. If the slaking has been properly done the milk of lime will fill two-thirds to three-fourths of the space; then water is added to bring the milk of lime up to the mark. After stirring thoroughly a gallon will contain the equivalent of 2 pounds of fresh lime.* It is essential that the milk of lime be well stirred, preferably with a broad paddle. If the clear limewater be taken it will contain only about $\frac{1}{8}$ ounce of lime instead of 2 pounds. However, as the slaked lime is only a trifle more than twice as heavy as the liquid and is in an extremely fine state of subdivision, it is found easy in practice to stir up the milk of lime in a few moments, so that it is of practically uniform composition throughout. The stirring must be repeated each time a quantity is dipped out. In settling, the lime leaves a clear layer of limewater above. This contains about 1 part in 800 of slaked lime in solution and absorbs carbonic acid readily from the air, forming a pellicle over the surface. The barrels of stock lime should be kept as closely covered as possible, though if not jarred the loss from this source is certainly very small in the course of a few days or weeks. However, it is best to slake all the lime as soon as received, and in case the barrels of stock lime have to stand more than a fortnight before being used, the barrel should be headed up tightly and either the head kept covered with water or the whole buried in the ground, as suggested by Mr. Waite.

PROPER RATIO OF LIME TO COPPER SULPHATE AND MEANS OF TESTING THE MIXTURE.

The almost universal practice in this country has been to use 4 pounds of lime to 6 pounds of copper sulphate. There has been advocated of

* In case the stock milk of lime is to be used at once, it will be necessary to allow it to cool, since the heat liberated during the slaking makes it very hot, and Bordeaux mixture made hot is different in composition, settles rather quicker, and is doubtless decidedly inferior to the mixture prepared at ordinary temperatures.

late, however, the method of Patrigeon,* i. e., adding the milk of lime gradually to the copper sulphate until the mixture no longer gives a brown precipitate with a solution of the yellow prussiate of potash (potassium ferrocyanide). In his bulletin on Bordeaux mixture, soon to be issued by this Division, Mr. D. G. Fairchild expresses doubt as to the value of this method. As usually recommended, it is certainly not by any means an easy method to apply, though it is often assumed to be so. If, as is usually the case, there is no means of knowing exactly how much lime is added, it is a tedious process to obtain enough without running the risk of using a great excess. As long as the amount of lime added is too small the mixture will give on adding a drop of potassium ferrocyanide solution a brown reaction plain enough to be seen against the greenish blue precipitates, but when nearly all the copper sulphate has been neutralized by the lime it is impossible to obtain the reaction without waiting for the mixture to settle and then testing the clear liquid. Well-made Bordeaux mixture settles very slowly and begins to deteriorate as it settles. Moreover, I am convinced that the mixture is not of as good quality when the lime is poured in little by little as when the proper amount is added all at once. By using the stock milk of lime described above, a definite idea is obtained of the amount of lime that has been added. Moreover, the proper ratio, when once carefully determined, can be followed without further testing in using up the rest of the two stock solutions tested. Lime must be added as long as a brown color is apparent, when a few drops of the solution is added to the mixture. A convenient way of making the test is to place a column of the mixture several inches deep in a small vial and add a few drops of the solution of potassium ferrocyanide.

Unless care be taken to add the milk of lime gradually, there is no assurance that there is not a large excess of lime in the Bordeaux mixture as prepared by Patrigeon's method. However, if the clear liquid obtained by letting the mixture settle be tested with a little copper sulphate solution, an excess of lime will be shown by a bluish precipitate being formed. If it forms instantly and is very dense, there is a large excess of lime, but if it forms only after standing a few minutes and is very faint and whitish, there is only a slight excess. If in a few moments the clear liquid turns red litmus paper blue, there is an excess of lime; if blue litmus paper turns red, there is an excess of copper sulphate present. A simple method of testing for copper sulphate (one nearly as sensitive as the potassium ferrocyanide and which can be applied without waiting for the liquid to settle) is to immerse the polished blade of a steel knife in the solution and notice if after a minute or two it becomes coated with copper. If it does become so coated

*Patrigeon, G. Revue Viticole. <Journ. d'Agr. Prat., 54[e] ann., t. 1., No. 20, May 15, 1890, pp. 700-704.

there is still copper in solution in the fluid. However, one of the best tests for the mixture is simply to notice the color. If too little lime is added it turns a greenish blue, if a slight excess is used the color is a beautiful sky-blue, and this is the color the mixture should show. If a great excess of lime is added the mixture takes on a slightly purplish shade of color, especially after standing a few hours. Probably the best test for the presence of an excess of lime, even when slight, is to pour some of the mixture into a broad, shallow vessel (a saucer for instance), and after a moment or two there will be formed a delicate pellicle over the whole surface. This pellicle can readily be seen if the dish is held to the light properly. It breaks when stretched and wrinkles when compressed. The amount of lime added is also a guide in the proper making of the mixture. Theoretically, 1⅓ pounds of lime are required to neutralize 6 pounds of blue sulphate of copper. With ordinary lime, however, this amount is insufficient. Usually it takes twice as much to throw down all copper in solution, viz, 2⅔ pounds. In general with good lime it is recommended that 3 pounds be used for every 6 pounds of sulphate of copper. This strength has been found very good for the lemon, which is injured by an excess of copper sulphate and also by any considerable excess of lime. It should never take more than 4 pounds of lime to neutralize 6 pounds of copper sulphate (unless a white or anhydrous copper sulphate has been used).

To sum up, properly made Bordeaux mixture should show a beautiful sky-blue color, and should form a faint membranc on the surface when exposed to the air for a moment in a broad dish. The clear liquid obtained on settling should give no brown color with yellow prussiate of potash solution, and should give a slightly bluish precipitate with copper sulphate solution. To obtain this result about 3 pounds of stone lime for every 6 pounds of copper sulphate should be used. Made in this way, the mixture is free from any copper in solution and also free from the greenish blue basic compounds, whose action on the plant is still in doubt. It contains a slight excess of lime very possibly beneficial to some plants, and certainly less injurious in slight excess than would be copper sulphate.

SHOULD THE MIXTURE BE MADE UP AS NEEDED OR MADE UP MORE CONCENTRATED AND DILUTED AFTERWARDS?

In using stock solutions of copper sulphate and lime, one or both may be diluted before they are mixed. I am convinced that it is of great advantage to dilute both solutions. In the mixture made from dilute solutions the chemical changes necessary to the formation are more quickly accomplished, and, best of all, the precipitates formed settle much more slowly. Ordinarily I would recommend diluting each constituent to one-half the amount the mixture is to make when completed. Then the two dilute solutions, after having been thoroughly stirred,

are poured together in the spray tank or barrel and again thoroughly stirred.* In making the mixture from diluted solutions it is best to have two vessels, each holding half as much as the tank; the proper amount of copper sulphate and lime stock can be measured out and each diluted without the trouble of measuring the water added. The superior quality of Bordeaux mixture made in this way will fully repay any extra labor of making. It does not suffice to dilute only one of the constituents.

KEEPING QUALITIES OF BORDEAUX MIXTURE.

The sooner the Bordeaux mixture is used after being made, the better. Changes in the precipitate soon begin; it eventually becomes coarsely granular, settles very quickly, and adheres very poorly to the foliage. Probably no serious degeneration of the mixture takes place inside of three or four hours, but there can be little doubt that it is decidedly of inferior quality after standing twenty-four hours.

ADDITION OF SOAP TO BORDEAUX MIXTURE.

As has been found by Galloway† and Fairchild, the addition of soap to the mixture greatly increases its wetting properties, and makes it much better for spraying plants having a waxy cuticle, and hence difficult to wet thoroughly. The exact nature of the chemical changes produced by adding soap is as yet almost unknown. The practice has been to add soap in solution until an abundant and permanent foam is produced upon stirring the mixture violently. Usually a considerable quantity of soap is required to produce this effect, about half as much as the total weight of copper sulphate and lime used. The soap should be in solution; with hard soaps it is best to shave into thin slices, dissolve in hot water, and add to the finished mixture warm. Soft soaps may be diluted and added cold.‡

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*For instance, in making given stock solutions containing 2 pounds of copper sulphate or lime to the gallon, in making a mixture of the strength of 6 pounds of copper sulphate and 3 pounds of lime to 50 gallons, the procedure would be as follows: Take 3 gallons of the stock copper sulphate solution and dilute with 22 gallons of water, making 25 gallons in all; after stirring well it is ready for use. Take 1½ gallons of the stock milk of lime and dilute with 23½ gallons of water, making 25 gallons. A mark can readily be made showing to what point the barrels are filled and rendering it unnecessary to measure the water added after the first time. After stirring both the diluted solutions well, pour them at once into a tank or barrel, straining through close-meshed wire netting. The mixture should now be thoroughly stirred with a broad paddle for at least two minutes.

†Galloway, B. T. Experiments in the treatment of rusts affecting wheat and other cereals. <Jour. of Mycol., vol. VII, No. 3, May 1893, pp. 195–226.

‡In this connection I would suggest that the very cheap resin soaps be given a thorough trial for this purpose. Take 2 parts of resin and 1 part of crystallized sal soda (sodium carbonate, Na_2CO_3, $10H_2O$), melt together in a kettle, stirring until all lumps disappear; then dilute with about 4 parts of hot water, which will make a stock solution containing 3 pounds of the soap to the gallon. This should be diluted

SUMMARY.

(1) Copper sulphate may be dissolved very easily by suspending the crystals in a loosely woven cloth or basket near the top of a vessel filled with water or by conducting steam into the vessel through a pipe.

(2) It is most convenient to make up a stock solution containing 2 pounds of copper sulphate to the gallon.

(3) Only the best freshly burned stone lime should be used in making Bordeaux mixture. When slaked it should be free from coarse granules.

(4) Stock milk of lime containing the equivalent of 2 pounds of unslaked lime to the gallon may be readily prepared.

(5) The method of testing Bordeaux mixture with a solution of potassium ferrocyanide to determine when enough lime has been added, is difficult to apply in practice unless stock milk of lime be used.

(6) The color of the mixture is a good indication of its composition. When properly made it is of a deep sky-blue color. Such a mixture contains a slight excess of lime, and on standing a few moments in a broad, open vessel is covered with a thin pellicle of calcium carbonate. The clear liquid left after settling gives no brown color with potassium ferrocyanide solution, but does give a slight precipitate of a light bluish color with copper sulphate solution.

(7) To obtain a mixture giving the reactions noted above, about 2½ to 3 pounds of lime will be needed for each 6 pounds of copper sulphate used.

(8) It is very much better to dilute both the copper sulphate solution and the milk of lime before mixing than to mix the strong solutions and dilute to the required quantity afterwards.

(9) The mixture begins to deteriorate within a few hours after being made and should therefore be applied as soon as possible. It should never be allowed to stand as long as twenty-four hours before using.

(10) The addition of soap to the finished mixture greatly increases its wetting properties and adds to its value for all plants with a waxy coating on the parts sprayed. The soap should be added in solution and in sufficient quantity to make the mixture foam well when stirred violently.

(11) The very cheap resin soaps are sufficiently promising to deserve a thorough trial for use with the Bordeaux mixture.

SUBTROPICAL LABORATORY,
Eustis, Fla.

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with about 2 parts of water when added to the Bordeaux mixture. This soap costs only about 1¼ cents a pound in large amounts, while whale-oil soap costs about four times as much, and ordinary good hard soap costs five to twelve times as much. From a few preliminary trials made, it seems to be even better than ordinary soap to make a foam with Bordeaux. Albert Koebele found a similar resin soap to be a good insecticide for some haustorial insects (see Annual Reports of the Commissioner of Agriculture for 1886 p. 558; 1887, p. 146; and 1888, p. 130).

A NEW METHOD OF TREATING GRAIN BY THE JENSEN PROCESS FOR THE PREVENTION OF SMUT.

By B. T. GALLOWAY.

During the past year Mr. Elam Bartholomew, of Rockport, Kans., a special agent of the Division, made some interesting experiments in the treatment of oat smut by the Jensen or hot-water process. Among other things, Mr. Bartholomew devised a method for treating large quantities of grain without resorting to the tedious basket-dipping process. The latter, he says, will answer fairly well for a few bushels of grain, but where a large acreage is to be planted the labor involved and the general inconvenience of the work will prevent many farmers from adopting the method. Mr. Bartholomew's method of treating 5 bushels of grain at a time was essentially as follows:

A common kerosene barrel was procured and after removing the head a 1½-inch hole was bored in the bottom close to the rim. The hole was then covered with a piece of wire window screen, the latter being tacked to the bottom of the barrel on the inside. A pine plug was then fitted to the hole from the outside in such a way that the end barely reached the fine wire screening. After making these preparations the barrel was placed on a box high enough to allow a pail or tub to be slipped under the bung. An old well bucket, such as are used in bored wells, was then obtained, and after removing the bottom, four rows of half-inch holes, running the entire length of the bucket, were punched. The holes were punched, as nearly as possible the same distance apart, six being placed in a row, making twenty-four in all. After punching the holes the bucket was placed in the center of the barrel, bottom end up, and resting on its bail, thereby raising it 4 or 5 inches from the bottom of the barrel and causing it to project a little above the top of the latter.

Holding the bucket in position, 5 bushels of badly smutted oats were emptied into the barrel. There were already on hand a common wash boiler and an iron pot filled with water which had been heated to boiling point on the cook stove. The contents of the two vessels were cooled to 130° F. by the addition of cold water, thereby increasing the quantity of liquid to 15 gallons. This was then poured into the bucket in the center of the barrel until all the grain was covered. The floating grain was pushed under with the hand and the barrel covered with a cloth to hold in the heat. After standing ten minutes the water was drawn off through the hole at the bottom of the barrel, the temperature in the meantime having fallen to 100° F. More boiling water was added to the water drawn off, until the temperature reached 133° F., when the liquid was again poured into the barrel and allowed to stand ten minutes, as before. Again the drawing off and heating process was repeated, the water being poured back into the barrel and allowed to

stand ten minutes. It was then drawn off for the last time and a new lot of grain put in and treated as in the first case.

Mr. Bartholomew says that seed treated in this way yielded less than one-tenth of 1 per cent of smutted oats, while in fields where no treatments were made 20 per cent of the grain is often affected with the fungus. A piece of 6-inch stovepipe, it is thought, will answer the same purpose as the bucket. The pipe should be arranged so that it will stand at least 4 inches above the bottom of the barrel.

FIELD NOTES, 1892.

By Erwin F. Smith.

[Plate XXXVIII.]

A NEW MELON DISEASE.

A widespread disease of muskmelon leaves was observed in southwestern Michigan in September. The foliage was destroyed almost completely over whole fields and the fruits failed to ripen. The symptoms suggested the work of a *Peronospora*, but an *Alternaria* or *Macrosporium*, supposed at first to be a saprophyte, was the only fungus found. Owing to the economic importance of this disease it will be made the subject of a special paper, the fungus having since been studied in the laboratory and the disease reproduced in the field by pure cultures made from single spores.

GRAPE POWDERY MILDEW.*

The powdery mildew of the grape was abundant on many varieties in an experimental vineyard at South Haven, Mich. The perithecia were well developed and numerous on September 19, although there had been no cold weather or frosts. This is opposed to Viala's hypothesis, that severe frosts are necessary for the formation of the perithecia.†

APPLE SCAB.‡

Apple scab was exceedingly severe in western New York and central and southwestern Michigan. There was an almost total absence of

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* *Uncinula spiralis* B. & C.

† Les périthèces sont relativement rares en Amérique; ils ne se produisent jamais qu'a la fin de l'automne lorsque les grands froids brusques surviennent et cela seulement dans les régions du Nord; ils sont surtout fréquents dans la Nouvelle-Angleterre. Dans Missouri, le Texas, la Californie, on ne les observe presque jamais; ils sont rares dans la Virginie. Il semblerait donc que les froids rigoureux arrivant brusquement soient nécessaires à leur formation.—*Une Mission Viticole en Amérique*, p. 283.

‡ *Fusicladium dendriticum* Fkl.

ruit, and the foliage was dwarfed, distorted, and blackened to an extent never before observed, and to such a degree that the trees made a feeble growth, were much injured, and bore no fruit the following year. In September the leaves of whole orchards in southern Michigan looked as if fire had run over them, and some of the trees seemed ready to die. Both in New York and Michigan the disease was correlated with many weeks of almost continuous rainy weather, commencing in early spring before the trees blossomed. It is not known just what destroyed the apple crop, but the almost universal failure of the trees to set fruit was attributed to the rainy weather. The failure to set fruit in 1893 is almost certainly attributable to the physiological derangements of the preceding year. In localities outside of these areas of excessive rainfall apple scab was not more prevalent than usual.

PEAR BLIGHT.*

In Kent County, Md., pear blight started in, or at least was first noticeable, about the middle of June, and was unusually prevalent during two weeks of very moist, hot weather. Some growers removed wagon loads of blighted limbs. Mr. Robert Emory, of Chestertown, cut over his large orchards seven times and in this way saved many trees. The orchards of Dr. W. S. Maxwell, at Still Pond, escaped entirely, although only about 12 miles from Chestertown, and subject apparently to identical temperature and rainfall. The only blight in these orchards of recent years has been that introduced artificially by Mr. Waite.

This disease was also very prevalent in Kent County, Del., where similar meteorological conditions prevailed. In both localities the disease was so bad as to cause much comment. In western New York and western Michigan pear blight was not widespread or severe, although, as noted above, the spring in both places was very rainy.

GOOSEBERRY LEAF-BLIGHT.†

The leaf-blight of the gooseberry was unusually severe in Maryland and Michigan. The leaves began to fall two months in advance of the proper season, and in many cases the bushes became bare before the fruit was picked. At Hubbardston, Mich., part of the fruit failed to mature on account of this loss of foliage, and in various other places the disease cut short the crop and materially diminished the vigor of the plants.

BLACK SPOT OF THE PEACH.‡

This spot disease was common on peaches at Benton Harbor, Mich., in September, and a series of rains caused the affected fruits to crack open quite generally, as previously described in this Journal (vol. V, p. 33).

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* *Bacillus amylovorus* (Burr.) De Toni.

† *Glœosporium ribis.* (Lib.) Mont.

‡ *Cladosporium carpophilum* Thümen.

CERCOSPORA (?) ON PEACHES.

Badly spotted Crawford Early peaches were received from A. A. Crozier, Ann Arbor, Mich., and later in the year the same disease was observed by the writer on other varieties at Douglas and Benton Harbor, Mich. In the specimens from Ann Arbor the spots consisted of small, roundish, slightly elevated portions, with a dead, yellowish center, and a dark, purplish brown circumference. In the most typical specimen, not over one-eighth of the surface was pitted, but that bore 50 spots, giving to the surface a very measly appearance. The central dead portion of the spot did not exceed a diameter of one-half mm. and often it was less. In the specimens collected at Benton Harbor a central white spot was surrounded by dead, brown tissue, which was ringed in turn by deep crimson. There was a mycelium in the spots suggestive of *Cercospora circumscissa*, but all of the spots were sterile and the fungus was excluded from the living tissues by a thick layer of cork.

Comparatively few fruits were attacked, and this is the first time anything of the kind has come to my notice.

PEACH MILDEW.*

A variety called Arkansas Traveler mildewed badly on the farm of William Smithson, at Youngstown, N. Y. No other variety in the orchard was attacked, and no other was destitute of glands at the base of the leaf blade (see Jour. of Mycol., vol. VII, p. 90). As heretofore, no perithecia were found in connection with this mildew, even when the examinations were continued until winter, and its identification is still doubtful.

PEACH CURL.†

Peach curl was rather severe in southwestern Michigan along the lake shore. On uplands, some miles away from the lake, it was less prevalent.

The sudden appearance of this disease under conditions such as were described in *Field Notes*, 1891,‡ i. e., following a decided drop in temperature, is due, according to N. A. Cobb, solely to unusual deposits of dew, prevaling at such times, and affording special facilities for the germination of the spores and the entrance of the fungus.

WILTING OF PEACHES ON THE TREE.

At Benton Harbor, Mich., during a few days preceding September 22, many Hales Early peaches partially separated from their peduncles and shriveled, and even fell from the trees. This was just in advance

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* *Sphærotheca pannosa?* (Wallr.) Lév.

† *Taphrina deformans* (Berk.) Tul.

‡ This Journal, vol. VII, p. 88.

of the time for picking, and the loss was very considerable. Hundreds of trees were affected, and there appeared to be no assignable cause, other varieties in the orchards "coming up" satisfactorily. In the orchard where the loss was severe the trees stood on a fertile upland of sandy loam, such as would produce an excellent quality of winter wheat. The trees had received good cultivation, and were well grown, thrifty, and full of fruit.

It has been suggested that this shriveling may be a varietal peculiarity, induced by exceptional meteorological conditions. If such be the case it is a strong argument in favor of discarding this variety altogether.

STEM AND ROOT TUMORS.

Tumors on the roots of peach trees have been found by the writer in several localities during the past few years, and have been reported from many parts of the United States. They occur on roots of all ages, and vary greatly in size, the largest ones being several inches in diameter. Usually these tumors are several to many times the diameter of the root, and are entirely unlike the small galls produced by nematodes. They also occur on stems above ground, peach trees thus affected having been received from Texas and Florida.

This disease occurs from New Jersey to Florida and westward to the Pacific, but at present it is most prevalent in Texas and California, where it is causing much anxiety. In California it attacks orchard trees as well as nursery stock, and seriously injures both. One nurseryman in southern California, writes as follows: "It attacks trees on dry and moist land in about the same ratio. I have found no conditions that will prevent it or any that will always black-knot a tree. I have had all of a certain lot black-knot and another lot alongside be almost free from it. My loss in nursery this year was 22 per cent. There is a great amount of it all over this State, and I think it is getting worse, many trees in bearing dying from the disease."

It has been observed by the writer on the peach, plum, almond, pear, and poplar, and it has been reported as occurring on the roots of other trees and shrubs, e. g., apricot, apple, fig, walnut, raspberry, blackberry, and vine, and root tumors of some sort certainly occur on these plants.

The inner tissues in young specimens of the peach and almond tumors appear to be entirely free from nematodes and fungi, bacteria, and phytomyxineæ, and their cause is involved in uncertainty. The most probable hypothesis is that they are due to some external irritant. Those who have the opportunity to examine early stages of this disease should certainly look for external parasites, especially animal organisms.

The general opinion of nurserymen who have had experience with this disease is that certain localities and often certain spots in a particular field are especially subject to it, and some believe it may be carried with the germinating seeds from the bedding ground into the

The Crown Gall.

nursery, and that the selection of a proper place for bedding pits is an important factor in getting rid of this disease. This belief rests on the fact that certain lots or blocks of trees are often specially subject to it while others are nearly exempt. The general appearance of these tumors on peach, pear, and poplar is shown in Plate XXXVIII. Some trouble has been experienced in finding a proper name for this disease, since the use of the term "root knot," which is already preempted for the root disease due to nematodes, would lead to endless confusion. In California this disease is sometimes designated the "crown gall," from the frequency of its appearance at the surface of the earth, and this name is, perhaps, as good as any, although the disease is not confined to this part of the tree.

ROOT ROT OF THE PEACH.

The specimen on which this report is based was received from Waco, Tex. The outer bark at the base of the trunk did not give indications of extensive injury, but on examination the entire inner bark was found to have been destroyed by a fungus which produced between wood and bark copious flat, white, mycelial strands, having a strong smell of mushrooms. Apparently the strands belonged to some hymenomycetous fungus, but there were no organs of fructification by which to identify it. The fungus may have entered the tree through two small injuries, which were probably due to borers, but the extent to which it had penetrated in all directions between the living wood and bark indicated that it was capable of living parasitically and that it was probably the cause of the disease. Trees attacked in this way are said to die gradually and usually first on one side. The top of this particular trunk showed signs of unhealthy growth in 1891, but matured a good crop of fruit. In 1892 it bloomed and set a fair crop, but died about the time the fruit ripened, part of the latter remaining on the tree in a withered condition.

Possibly this decay is the work of *Armillaria mellea*, but no rhizomorphs were found. At any rate it is a disease which has been reported only from the Southwest, no cases ever having been observed by the writer in the peach-growing regions of the northern and eastern United States, where peach yellows is prevalent and where we should expect to find such symptoms frequently if hymenomycetous fungi were the cause of yellows.

DESCRIPTION OF PLATE.

PLATE XXXVIII. The crown gall. Fig. 1, Lombardy poplar, crown affected, Arizona. Fig. 2, fresh pear stock, crown affected, Maryland. Fig. 3, peach, crown and roots affected, California. Fig. 4, peach, stem above ground affected, Florida. All photographs, natural size, from young trees.

REVIEWS OF RECENT LITERATURE.

ALTEN H., UND JÄNNICKE, W.—*Eine Schädigung von Rosenblättern durch Asphaltdämpfe*: <Bot. Zeit., 49. Jahrg., Leipzig, March 1891, pp. 195–199; *Nachtrag zu unserer Mittheilung über "Eine Schädigung von Rosenblättern durch Asphaltdämpfe."* <*Ibid.*, Sept. 25, 1891, pp. 649–650.

What Prof. H. Marshall Ward has done for the parasitic disease of plants caused by *Botrytis* has been accomplished by the authors of the present papers for a nonparasitic disease of rose leaves caused by asphalt vapor; that is to say, a rational and connected account has been given of the exact course of the malady. The rose leaves in a garden were injured in a very peculiar manner by asphalt vapor generated during the construction of a neighboring street. The injury was noticed in a strip running 150–200 meters southwest from the asphalt kettles. The injury was seen after a rain accompanied by northeast wind. During clear weather no injuries were observed. The injured leaves showed a pronounced browning of the upper surface, became withered, and finally fell. In many instances the twigs bearing such injured leaves also died. A remarkable fact was that only the upper side of the leaves exposed to the rain were browned. Inverted leaves were browned on their under surface. When one leaf lay over another the under one was free from injury. Microscopic examination showed that only the epidermal cells were damaged, these having a brown, granular cell content. There was a great difference in the amount of injury to different plants; roses were injured most and then strawberries, while delicate-leaved begonias remained entirely sound. Such, in brief, were the symptoms of the disease, and to explain the exact manner in which the asphalt vapor caused the peculiar injuries was now the task of the authors. The action of poisonous gases (such as sulphurous acid) was excluded by the fact that only the upper surfaces of uncovered leaves suffered. Sections showed that there was no appreciable deposit on the upper surface of the leaf, and consequently the damage was not due to a body mechanically carried down and deposited by the rain on the leaves. It then became clear that the injury must be due to a soluble substance brought down by the rain and absorbed by the leaves. Curiously enough, the character of the epidermal wall seemed to exercise no influence in the matter, since delicate begonia leaves were spared, while coarse rose leaves, with thicker-walled epidermal cells, suffered. One thing, however, was soon determined, and that was that the injury stood in definite relation to some substance held in solution in the cell sap. The amount of injury to the cells was found to depend upon the amount of tannin contained in them. This explained why begonia leaves were exempt, for they

ıtained no tannin. It was now necessary to determine which con-
tuent of the asphalt vapor caused the precipitation of the tannin.*
[t was found that slight quantities of iron were contained in the vapor
ıl that this caused the damage. The iron was supposed to be in the
ın of ferrous salts or possibly in the finely divided metallic state. In
ɛ "Nachtrag" the authors report the results of trials made to deter-
ııe the effect of various iron salts on rose leaves. Metallic iron in
ṡpension failed to produce the very evident coloring of the epidermal
lls; ferrum redactum caused dark spots here and there, but ferrous
d ferric chloride and ferrous and ferric sulphate in solution produced
lark coloration resembling that caused by asphalt vapor. All four
lutions last mentioned, with the exception of ferric chloride, brought
ıout a precipitation of the contents of the epidermal cells. Ferric
lts also injured the chlorophyll grains, turning them yellow. These
periments confirm the authors in their supposition that the injuries
the rose leaves were due to iron present in the asphalt vapor. Such
ıpers as this are genuine contributions tc vegetable pathology, and
is to be hoped that their numbers will increase in the future.—W. T.
WINGLE.

OOKE, M. C.—*Handbook of Australian Fungi.* London, 1892, pp. XXXII, 458, pl. 36.

This volume, the latest of many that have appeared from the pen of
r. Cooke, is a useful addition to the literature on fungi, and must
e welcomed by all students fortunate enough to secure a copy. Only
limited edition has been printed, and the larger part of it has gone to
ıustralia. The reason for this is manifest from the title page, for it
ṡ there stated that the volume is "published under the authority of the
everal governments of the Australian colonies," "for the Departments
f Agriculture in Melbourne, Brisbane, Sydney, Adelaide, Hobarton."
'he value of the book does not arise from any novelty of arrangement
r description of new species, but in its being the collection of descrip-
ions scattered through many widely distributed and frequently nearly
ıaccessible papers and monographs. It embodies the latest views of
he author in regard to classification, a subject now receiving general
ıttention from students. As will be seen, Dr. Cooke is not in entire
ccord with some of the newer schemes presented for acceptance.

*It is probably the weakest point in the paper that this tannin (Gerbstoff) was not more carefully studied. Le Merchant Moore has shown (On Epidermal Chlorophyll, Jour. of Bot., vol. XXV, p. 362) that the epidermis of some plants contains a substance giving the reactions of tannin with iron salts, but showing a blue or purple color with iodine and failing entirely to give the reaction for tannin with potassium bichromate, either alone or with iron salts and Millon's reagent. Kraus, however, considers this a tannin, but Dufour (Recherches sur l'amidon soluble, Bull. Soc. Vaud. d. Sci. Nat., vol. XXI, No. 93, 1886) regards it as a carbohydrate. Reinitzer (Der Gerbstoffbegriff. <Lotos, neue Folge, 11, 1891) insists that simply calling a substance tannin tells almost nothing of its real nature, especially in a case like this, where we are in doubt as to the exact reactions it gives.

The total number of species represented in the volume, exclusive of varieties, is 2087.* This, in comparison with the total number of species recorded by Saccardo, some 36,000, seems, and is, small, when the whole extent of the country covered is taken into account. But it is of course very improbable that all the Australian forms have been described. Indeed, scarcely a month passes but some new species are recorded, and it is probable that they will continue to be sent in for many years to come. The various orders are represented by species as follows:

Hymenomyceteæ	1,178
Gastromyceteæ	174
Ascomyceteæ	341
Phycomyceteæ	12
Hypodermeæ	103
Sphæropsideæ	114
Hyphomyceteæ	117
Myxomyceteæ	48

The largest order, Hymenomyceteæ, probably occupies this place because of the generally large size of the plants embraced in it. These being easily seen are naturally collected. At the same time the second order, Gastromyceteæ, has 174 out of a total known from the whole world of 650 species. "From this we conclude," Dr. Cooke remarks, "that Gastromycetes are unusually strong in Australia, certainly including some interesting genera not hitherto discovered elsewhere, but weak in subterranean species."

The occurrence of a number of species in Ceylon and Australia is noted as a curious fact in geographical distribution. For example, numerous species of *Lepiota*, a subgenus of *Agaricus*, occur in both places; others, like *Kneiffia mulleri*, *Hymenochæte strigosa*, *H. rhabarbarina*, *Stereum pusillum*, *S. sparsum*, *Coniophora murina*, *Aseröe zeylanica*, and *Epichlöe cinerea* are found nowhere else than in Ceylon and Australasia. Comparing the flora with that of Europe, Dr. Cooke finds that of the Hymenomycetes 332 are exclusively Australian, 472 are Australian and European, and 370 are common to Australia and some other country exclusive of Europe. Of the Gastromycetes only 31 out of 173 species are European. The Myxomycetes are still regarded as fungi, notwithstanding the efforts to separate them as *Mycetozoa*.

A useful portion of the introduction consists of condensed accounts of the principal groups, with tables of the genera. This, while not claiming to be complete, can not but be of assistance in recognizing the larger groups and the genera. The species will have to be studied up from the descriptions. These, however, are well supplemented by 36 plates, with 377 figures. Twenty plates, with 175 figures, are colored.

* The slight discrepancy between this number and that given by Dr. Cooke in the introduction is due to the addition here of a few interpolated and duplicate numbers left out of his count in the general total.

These include the three groups, Hymenomycetes, Gastromycetes, and Discomycetes. In the second of these are some peculiar Phalloids and Lycoperdaceæ. Among the latter is *Podaxis indica*, which bears a surprising outward resemblance to *Coprinus comatus*, although, of course, the interior structure is widely different. There is also *Xylopodium ochroleucum*, with a long stalk and a peridium marked with angular projections.

Only one change seems to have been proposed in nomenclature. This is the substitution of *Platycheilus* for *Tryblidiopsis*, preoccupied. A list of authorities cited and a full index are valuable portions of the book. The descriptions of the plates would have been more convenient for reference had the pages where each species is described been given.—JOSEPH F. JAMES.

HABERLANDT, G.—*Eine botanische Tropenreise: Indo-Malayische vegetationsbilder und Reiseskizzen.* Pp. VII, 300, fig. 51. Leipzig, 1893.

An account of a six months' trip from Triest to Java via Bombay and Singapore, and return via Ceylon and Egypt. Most of the time, November to February, was spent in the hot, rainy region of West Java, where the yearly rainfall is 4½ meters, and the mean annual temperature 25° C., with a difference of only 1° between the mean of the warmest month, September, and that of the coldest, February. In spite of what would seem to be favorable conditions, parasitic fungi in West Java are comparatively rare. The author thinks this may be due to the fact that the spores do not find lodgment, the foliage on a great many plants being thick, hard, and smooth, so as to be washed clean by the daily rains and quickly dried. If the leaves were hairy, so as to hold the spores and retain moisture, the opportunities for attack would be better. In some of the thickets the growth from the interweaving of lianas is so dense that fallen branches and foliage do not reach the ground, but gather in masses, like thatch of roofs, and over and through these, anchoring here and there, clambers the black and brown liana-like mycelium of a fungus resembling *Marasmius*—fungus-lianas, the author calls them.

During the nine days spent in Ceylon the following facts were gathered relative to the coffee rust (*Hemileia vastatrix*). The extensive and beautiful coffee plantations so graphically described by Haeckel, have been almost entirely destroyed and the land is now devoted to other purposes, e. g., tea-growing. The first coffee plantation was set out in 1825, and the business proved so remunerative that a vast extent of upland country was devoted to it, and coffee-growing and speculation became the rage. The leaf rust appeared in the seventies, and no radical means were found to check its rapid spread. The influence of this disease was felt in every branch of business and a great many people were financially ruined. Many of the plantations can now be had for one-tenth their former value, and the total depreciation in real estate

is estimated by the German Consul General, P. Freudenberg, at about ten million pounds sterling. This disease also occurs in Java, but its ravages there have been partly offset by the introduction of a more resistant species of coffee, *Coffea liberica* from West Africa, which also yields more fruit and endures the hot Javan climate very well, even down to the coast.

Both in India and Java variegated plants are common and are used for ornamental purposes so extensively as to form a characteristic and striking feature of the garden landscape.—ERWIN F. SMITH.

MAYER, ADOLF.—*Ueber die Mosaikkrankheit des Tabaks.** <Landw. Ver. Stat., vol. XXXII. Berlin, 1886, pp. 451–467, pl. 1.

Tobacco plants in parts of Holland are subject to a variegated leaf disease. This is sometimes so serious as to take the whole crop, but ordinarily only scattered plants in the field are affected and there is no indication of infection from plant to plant, although sometimes several affected plants may be together.

The disease generally appears three to five weeks after the plants have been set out, when they are well rooted and have begun to grow vigorously. The first symptom is a geographic or mosaic coloring of the leaf surface, light and dark green, but otherwise the leaf appears sound. Soon with assistance, and a little later to the naked eye a considerable number of thickenings are visible in the green spots. These green spots grow so much more than the pale places that there are numerous irregular bendings of the leaf surface. Finally the light parts die early. The dark parts of the leaves also take on in later stages of the disease a transparent and lac-colored shade. When a single leaf is attacked all the younger leaves are sure to be, but at first only show earlier stages. The injuries caused by the disease are:

(1) Limitation of growth and a smaller harvest in consequence.

(2) Curling (wrinkling) of the leaves and unsuitability for cigar manufacture.

(3) Brittleness with the same result.

(4) Imperfect ripening and therefore incomplete (*schlechter*) burning, also injury of the aroma, so far as this can be said of any European tobacco. Once only the author found a little of the disease at Karlsruhe, in south Germany. The growers call the disease bunt, rust, and smut. The name "mosaic disease" was given by Dr. Mayer.

Dr. Mayer undertook a prolonged investigation to determine the cause of this disease. The opinions of practical men as to the cause were extremely diverse. The attention of the experiment station (Ryksproef

*This paper appeared some years ago, but seems to have been generally overlooked by botanists, owing to its place of publication. The subject is one of much interest and it is believed that readers of the Journal will be glad of an abstract. A recent letter from Dr. Mayer states that no microorganism has yet been isolated from the fected plants.

Station zu Wageningen) was first called to this disease in 1879 by the transmission of healthy and diseased leaves, with the inquiry: "Was mag der Grund sein, dass in den letzten Jahren die Tabakspflanze so sehr leidet durch den sogenannten Rost?"

A comparative chemical analysis was first made of healthy and diseased leaves. This showed no lack of N, K, or Ca in the diseased leaves. In tobacco culture there is under ordinary conditions no lack of P_2O_5, because the plants make only moderate demands on this substance, and in the culture methods here in vogue an excess is given to the soil. Analyses of the earth from tobacco-sick fields also showed that there was no deficiency of plant food. Tobacco is known to be very greedy for lime, and consequently a sick earth and one not subject to the disease were compared. The lime content was small in both, but not essentially unlike. These determinations, combined with the results reached by experienced growers, seemed to show that the disease was not due to defective nutrition.

A search was then made for nematodes in healthy and sick earth. Some were found, but only such as live in humus, and no connection between them and the disease was established.

Plants were grown in specially constructed seed beds, with varying temperatures, degrees of moisture, and amounts of nitrogen, and their behavior after transplanting closely watched. They all developed normally, remained healthy, and were very fine at the end of summer, but not so large as those grown in the regular way and set out somewhat earlier. The plants were also set out with twisted and injured roots, but this was harmless. All grew into fine plants.

Plants were also grown at high temperatures in moist air and suddenly transported to the field. No disease resulted.

The hypothesis that crowding and etiolation in the seed bed might be a cause of the trouble was also tested and found wanting. In 1881 the disease was common, and the author had good opportunity to study it near Wageningen and Rhenen. Here for the first time it was observed that foreign kinds of tobacco escaped the disease entirely, while the disease was not completely absent from any of the sorts commonly grown.

In 1882 various experiments were made to determine whether self or cross-fertilization played any part. Plants from the seeds of diseased plants were also grown. None of these experiments had any influence on the disease. As usual it appeared on land subject to it and did not appear in other places. All these results seemed to indicate a disease due to parasites.

The tissues were searched zealously for fungi, animal parasites, etc., not only by the author, but also by several of his friends. At first no results were obtained. Only one authority thought he found a mycelium in the diseased parts of the leaves, "die sich zu einer Septoria oder Phoma entwickeln dürften." It was at this time Dr. Mayer discovered

that the disease could be induced in healthy plants by inoculating them with the expressed juice of diseased plants. By rubbing up a plainly diseased leaf in a few drops of water, taking up a little of this thick, green emulsion in a glass tube drawn out to capillary size, and sticking it into the thick midrib of an old leaf so that it remained without reaching through to the back side, sound plants became badly diseased in nine cases out of ten. The period between the inoculation and the first doubtful symptoms was quite regularly ten to eleven days. After this period the disease appeared without failure in all the younger leaves, i. e., those undeveloped at time of inoculation, and on the small shoots which developed in the axils of the diseased leaves. All the younger parts of the plants were diseased, exclusive possibly of the flowers, and all the older parts healthy.

It is self-evident that the disease is more severe in proportion to the youngness of the plant at the time of inoculation. It is much less dependent apparently on the quantity of inoculated substance (*Impfstoffs*). It is only necessary to be careful that the substance is really taken up by the plant, and this is best brought about by using a thin fluid and infecting slightly wilted plants.

After this discovery organized bodies were sought in the sap of the diseased plants with new zeal, but owing to the numerous almost colorless granules normally present in the juice no definite results were obtained. Some of these granules were not unlike red blood corpuscles, but more half-moon shape, while others were smaller. The sap was also rich in small tetrahedral bodies, which slowly disappeared in HCl, and which were probably calcium oxalate. The bodies in the sap appeared, even with the highest powers, of such indefinite form that they could not be identified with any certainty as organized bodies.

Later Dr. Mayer endeavored to isolate the supposed organisms by Koch's and other methods, and demonstrated bacteria in many cases. But none of these, when used for inoculation, caused the disease. He also inoculated sound tobacco with various bacteria, dung solutions, extract from tobacco, sick earth, etc., but without result.

The question now arose whether the disease was due to an organized or a chemical ferment. A chemical ferment seemed improbable. This sort rarely causes a disease, and it is unheard of that an enzyme multiplies from itself. An organized ferment might be a fungus or a bacterium. To determine these points the following experiments were undertaken:

The infectious fluids were passed through ordinary filter paper and the filtrate used for a large number of additional inoculations. Result: The filtered sap worked almost as well as the unfiltered. The per cent of diseased plants was only a little less. Either the disease was due to chemical substances or else to organized bodies small enough to pass through the pores of the paper. A clear filtrate was finally obtained by using a double filter, and fluid passed through this possessed no infective power. Evidently the cause of the disease was

filtered out and could not be a chemical ferment, for it is opposed to all known peculiarities of enzymes to be filtered out of solutions. The common method for the concentration of an enzyme, i. e., precipitation with not too strong alcohol from the crude juice and re-solution in water, was tried. This led to no substance which had infective power.

Inoculations with heated sap led to the following results: Persistent warming at 60° did not perceptibly alter the infectious power; at 65° to 75° it was weakened. Heating the sap at 80° for several hours killed the infective power. These experiments show that the infective substance satisfies the requirements of an organized ferment, and indicate that the infective body must be searched for among the small organized bodies. Fungi are much too large to pass through filter paper, and if the disease was due to these it would seem that they must assume at some stage some more easily visible form.

The following is a rather literal rendering of the author's conclusions:

(1) The "mosaic disease" of tobacco is a bacterial disease, the infective organism of which has not yet been isolated so as to know its form and mode of life.

(2) The infective power of the disease from plant to plant under the artificial conditions of sap mixture has been established with certainty. Under natural conditions there is no plain infection from plant to plant. The seeds of diseased plants can produce sound plants.

(3) The cause of the disease must be sought in the earth of the tobacco fields and the hotbeds, for particular fields, especially those in which tobacco follows tobacco, are most exposed to the disease. A case of transportation of the disease with earth, however, was not established.

Rotation of crops is advised, also the removal of the diseased plants, and after harvest all remnants of the crop.—ERWIN F. SMITH.

MOELLER, H.—*Entgegnung gegen Frank, betreffend den angeblichen Dimorphismus der Wurzelknöllchen der Erbse.* <Ber. d. Deut. Bot. Ges., Bd. x, Nov. 24, 1892, pp. 568-570.

In a recently published note upon root tubercles, Frank states that those of the pea show two forms that differ externally, but have the same internal structure, and furthermore that the content is different, being albumen bacteroids in the one, and amylodextrin bacteroids in the other.

The author of this paper proved some time ago that these tubercles do not contain amylodextrin, but a waxy substance, and this fact made him doubt the correctness of Frank's observations. He has also studied the exterior form of such tubercles and states that vigorous specimens of pea show a considerable variety of such tubercles, but without any distinction of two special forms. An examination of their contents gave only albumen bacteroids. These investigations were

made when the plants were at the end of their vegetative period, while those of Frank were made shortly before their flowering, a fact that might have led to the difference in results.

In *Trifolium* the tubercles are developed all the year round without being dependent upon the growth of the plant. It would appear that the biological process in these tubercles consists in the bacteria becoming transformed into bacteroids by a certain kind of hypertrophy, and that when dead the organisms are resolved into a fatty substance. The author is unable to believe in anything like a reabsorption of the bacteroids. The result of his examinations shows that the tubercles are not to be differentiated, either in their shape or in regard to their contents; thus no dimorphism is observable.—THEO. HOLM.

Report on recent experiments in checking potato disease in the United Kingdom and abroad. London, 1892, pp. 193, figs. 5.

Notwithstanding the fact that the potato is the standard crop, constituting the larger part of the food of the people of Ireland, and is an important product of England and Scotland; that the vegetable is known to have been affected by fungi since 1844; that the disease has in some years been so severe as to cause tremendous losses and even a famine in Ireland; and that for the past six years the disease has been known to be successfully combated by copper compounds, still the authorities of Great Britain do not seem to have made any attempt to prevent the disease by treatment with these compounds until 1891. It is true that when the results of experiments made in France in 1888 became known, the attention of the Government was called to them, but without any result, save the issuance of a report or two. In 1891 the Royal Agricultural Society of England began to make some experiments. The board of agriculture also began to bestir itself and to inquire of foreign consuls what progress had been made in checking the disease. The results of the experiments and inquiries are embodied in the report at present under notice, and which was issued by the board of agriculture in the spring of 1892.

The report is divided into four parts: Part 1, contributed by Charles Whitehead, consists of a history of the disease; its cause; the life history of the fungus; and the action of "bouillie bordelaise," or Bordeaux mixture, as it is commonly called. From this introduction it appears that although in 1846 Berkeley had shown the disease to be caused by a fungus, agriculturists generally up to as late a date as 1872 believed the fungus to be the effect rather than the cause. This is shown by the fact that out of ninety-four essays submitted as the result of an offer of £100 for the best account of the trouble and its remedies, not one was deemed worthy of the prize, and not one contained correct ideas as to its origin. This is certainly remarkable when we remember the number of able botanists which England possesses and the demonstration by Berkeley twenty-five years before. The idea also at one time pre-

vailed that there were disease-proof varieties of the potato, but this was speedily disproved by experiment. In the discussion of the action of Bordeaux mixture the rather remarkable statement is made (p. 22) that "at present there are no clearly defined formulæ." It is difficult to understand how anything can be made more definite than the formula given for the Bordeaux mixture in Circular No. 4 of the Section of Vegetable Pathology, U. S. Department of Agriculture, issued in July, 1889. While the formula has since been modified, the directions there given were sufficiently explicit.

The second part deals with the experiments conducted by the Royal Agricultural Society in Great Britain and Ireland in 1891. These experiments were made in various places and under varied conditions, and the results were not in any way uniform. In some no benefit was reported, while in others it was very marked. The general conclusion reached, however, was that when applied at the proper time and in the proper way a decided benefit was derived from the use of Bordeaux mixture.

The third part deals with the experiments for checking the disease and the culture of the potato in foreign countries. Eleven questions were submitted to the representatives of Great Britain in Austria-Hungary, Belgium, Denmark, France, Germany, Netherlands, and the United States. These questions related to the varieties usually grown, changes of seed, methods of seeding, frequency of cropping, manner of cultivation, manures used, occurrence of disease, precautions taken against it, measures to prevent its appearance, remedies adopted, and the results of the treatment. We have here a digest of the experiments made in the countries mentioned, and it is valuable as a compilation of late information. The experiments in France, Belgium, and Holland are especially referred to, and in some cases given in full. Part 4 gives a summary of reports on potato culture in the colonies, mainly those of Australia, where, however, the disease either does not exist or does but little damage. It occurs to a greater or less extent in the Bermudas and on the Cape of Good Hope.—JOSEPH F. JAMES.

SARAUW, G. F. L.—*Rodsymbiose og Mykorrhizer særlig hos Skovtræerne.* <Bot. Tidsskrift, vol. XVIII, Copenhagen, 1893, pp. 134, pl. 2.

The present paper contains a complete account of the various theories and explanations which have been given of the "root symbiosis and the Mycorrhizæ." It contains abstracts of a large number of papers from the earliest up to the present time, while the original investigations of the author are merely alluded to. It should be pointed out that the present paper represents only the historical part of a comprehensive work entitled "Bögens Svamprödder," for which the author was awarded the prize of the Royal Danish Academy of Sciences.

The various forms of parasitism are discussed as "antibiosis" and "symbiosis," terms which were proposed by Vuillemin (1889), and which

correspond to the difference between "antipathy" and "sympathy." The author defines, however, the "antibionts" to be those beings which live in a constant struggle with each other, while the "symbionts" live in peace and do not cause any injury to each other. Whether these "symbionts" are of any mutual benefit is another question. This conception of symbiosis was given by Tubeuf in 1888, who called it "harmless symbiose."

It is a marked characteristic of the antibionts that their action very soon ends the struggle, and their appearance is, therefore, rather limited. The symbionts, on the other hand, may be observed as constant companions for many years. Antibiosis and symbiosis may, when considered in this way, represent an acute and chronic parasitism.

The chapter dealing with the appearance of the "root symbiosis" comprises the "algal symbiosis," as we know it from the lichens and Hepaticæ, and the "fungal symbiosis," which causes the development of root tubercles and similar hypertrophy of roots or organs which have the same function as the proper roots, such as fronds with rhizoids like those of Hepaticæ, etc. It seems as if Dalechamp (1587) was the first to describe and figure the root tubercles of the Leguminosæ, while Malpighi (1679) also described them, and considered them as galls, caused by insects. Concerning the morphological identity of these tubercles, the Danish botanist Didrichsen (1867) explained them as being lateral roots. The anatomical structure was given by Van Tieghem (1888), who showed that they differ from normal roots by having several central cylinders within a common bark. Their first development is, however, to be traced, as in normal roots, from the pericycle of the mother root. But besides the Leguminosæ, several other plants are mentioned as having similar tubercles, both trees and herbs, from the cycads and conifers to the annual *Junci* and *Cyperus flavescens*. The identification of most of the fungi which cause these various hypertrophies, is a very difficult task if indeed a possible one. Only a very few are known thoroughly, such as *Frankia*, *Rhizobium*, etc.

Frank was one of the earliest writers in the field and has written much. He appears to have been the first to demonstrate one phase of the question as to the biological importance of the fungal symbiosis. This author claims that certain trees, especially all the Cupuliferæ, are unable to take nourishment from the soil by themselves. but that they become nourished by means of the fungous mycelia which surround their entire root system and nurse them from their earliest stage until their death.

Gibelli, on the other hand, considers this symbiosis as a mere question of tolerance on the part of the root, and if we consider the entire literature upon this subject, it seems as if the majority of authors agree with Gibelli, that the fungus is tolerated by the root only because it does not cause it any injury.—THEO. HOLM.

TAVEL, F. VON.—*Vergleichende Morphologie der Pilze.* Jena, 1892, 8vo, pp. 11, 208, figs. 90.

This book puts the whole Brefeldian system into such a compact and lucid form that he who runs may read. The revolutionary work done by Dr. Brefeld and his assistants during the last twenty years in every group of fungi and embodied in ten large "Heften," with more to follow, is here condensed into less than 225 pages, and yet completeness and perspicuity of expression, so far as regards essential features, are everywhere apparent. That Dr. von Tavel is well fitted for this task goes without saying, since he was Dr. Brefeld's assistant for a number of years, and is joint author with him of Heften IX and X on Hemiasci and Ascomycetes.

According to the views here set forth, fungi consist of two primary groups: (1) The Phycomycetes, or algal fungi, consisting of a single cell and having sexual functions; and (2) the Mesomycetes and Mycomycetes, or higher fungi, consisting of a many-celled thallus and entirely destitute of sexual organs. The Phycomycetes have a thallus resembling that of the Siphoneæ and were undoubtedly derived from the algæ. They subdivide naturally into two quite distinct groups, the Oomycetes and Zygomycetes. The Oomycetes resemble the Oophyceæ both in the thallus and in the reproductive system. In each group the organism consists of a nonseptate, sparingly branched cell, which reproduces sexually by antheridia and oogonia, and nonsexually by swarm spores developed in sporangia. But the Oomycetes show degenerations and retrogressions which appear to be adaptations to a more terrestrial life. Especially noteworthy is the progressive loss of sexuality.

The group is divided into six families, including Entomophthoreæ, which stands midway between Oomycetes and Zygomycetes, having reduced antheridia and oogonia which conjugate, and an abundant conidial fructification. Beginnings of conidial fructification also appear in some of the other families. In Zygomycetes the thallus is one-celled and agrees completely with that of the Oomycetes, but the fructification is different. In this group there is still further degeneracy in the sexual reproduction. Instead of the union of specialized sporangia (antheridia and oogonia) to produce the zygospore, there is simply a conjugation of the slightly differentiated beginnings of such sporangia, i. e., the conjugating threads are only slightly swollen and the male and female organs can not be distinguished. Nonsexual sporangia are present as in Oomycetes, but the spores have lost their cilia with the more decided adaptation of these plants to a dry-land life. In the possession of a one-celled thallus the Zygomycetes are also like the algæ, and they resemble the Conjugatæ in conjugation, but not otherwise. The first five families are exosporangic, producing sporophores anywhere on the mycelium; the other two, Rhizopiæ and Mortierellaceæ, have progressed a step further and are carpo-sporangic, bearing their sporophores on specially

differentiated, stolon-like threads, which arise from the ordinary mycelium.

The higher fungi, i. e., the most highly developed, consist of the Ascomycetes and Basidiomycetes, or so-called Mycomycetes, and the intermediate Hemiasci and Hemibasidia, the so-called Mesomycetes, connecting the higher fungi with the Phycomycetes. The sexual organs, which are destitute of function in some of the Oomycetes and still further degraded in Zygomycetes, disappear altogether in the higher fungi and are not found even in a rudimentary state, whereas nonsexual methods of reproduction take on a compensating multiplicity of forms. Originally the nonsexual form was a sporangium, as in *Mucor mucedo*, and its change into a spore (conidium) can be followed step by step through the Thamnidiæ and Chætocladiaceæ. In the Choanephoreæ the conidia are still accompanied by the sporangia, but in the Chætocladiaceæ the latter have disappeared, and it is precisely from this group of Zygomycetes that the Basidiomycetes appear to have arisen. From this point of view there are three types of Zygomycetes: (1) Forms with sporangia only, (2) forms with sporangia and conidia, (3) forms with conidia only. Among the sporangial forms, moreover, *Mortierella rostafinskii* shows a distinct advance into a sporangial fruit, the beginning of which may be seen even in Rhizopeæ. Finally, in *Chlamydomucor racemosus* there has developed an additional, purely accessory spore, the chlamydospore, which occurs either as a chlamydospore proper or simply as an oidium. As already stated, all of these nonsexual spore forms, sporangial, conidial, and chlamydosporous, occur in great variety in the higher fungi. In the Hemiasci and Ascomycetes we have forms which fructify in sporangia only, or by sporangia and conidia, and these may be designated the *sporangial series* of the higher fungi. On the contrary, in the Hemibasidia and the Basidiomycetes there are no sporangia, but only conidia. These fungi evidently had their origin in the Zygomycetous Chætocladiaceæ and may be designated the *conidial series* of the higher fungi. Chlamydospores occur in both, and both sporangia and conidia are modified and specialized. The sporangium in Zygomycetes varies as to form, size, and number of its spores in the same species, but in the higher fungi definiteness becomes more and more pronounced until in Ascomycetes the sporangium becomes an ascus having a determinate shape and bearing a definite number of spores. In these particulars the Hemiasci form a transition group, their sporangial fructification being ascus-like, but more variable than in Ascomycetes. In the conidial series it is the conidiophore which has become specially developed. In Zygomycetes also the conidiophore varies in form, size, and number of its spores. In the Basidiomycetes it has been specialized into a basidum of definite form and bearing a definite number of spores. Here, again, there is an intermediate group, the Hemibasidia, connecting the basidia-bearing forms with the much simpler Zygomycetes. The accessory spore form, i. e., the chlamydo

spore, remains indefinite in both series. According to this view, all of the higher fungi had their origin in Zygomycetes, and the two series simply developed in different directions, one series excluding sporangia and developing specialized conidiophores (basidia), while the other series retained indefinite conidiophores, but developed sporangia of a very precise character (asci).

The Hemiasci consist of three families, (1) Ascoideæ, (2) Protomycetes, and (3) Theleboleæ. In these simple forms the sporangium becomes ascus-like, but is still indeterminate as to form, size, and number of its spores. The spores are usually shot out with considerable force, showing in this particular a greater adaptation to terrestrial life than is found in most Zygomycetes. The Ascoidæ have free sporangia, as in Mucor, and conidia. The Protomycetes also have free sporangia and conidia, but the former are preceded by chlamydospores. The Theleboleæ have sporangial fruits, the condition seen in *Mortierella rostafinskii* having been carried a step farther by the reduction of the sporangiophore to a mere rudiment and the extension of the basal weft of mycelium into an envelope.

The Ascomycetes are characterized by the presence of the ascus, which is simply a sporangium that has become determinate in form, size, and number of its spores. In very many cases this form of fructification is accompanied by conidia and chlamydospores. When ripe the spores of most Ascomycetes are shot out of the ascus with great energy. Sexual organs do not occur in any of the forms, and the earlier observations ascribing sexuality to various Ascomycetous fungi are misinterpretations. The Ascomycetes are divided into Exosporangial and Carposporangial forms. The Exoasci are the simpler, having naked asci, borne directly on the mycelium. They include two families, Endomycetaceæ and Taphrineæ. The Carpoasci, which form the bulk of the Ascomycetes, have fruit bodies. The asci are not naked and do not arise directly from the mycelium, but in special organs, which are composed of fertile or asci-bearing hyphæ, and of sterile threads, which form the walls of the envelope. In most cases asci are not borne singly, but in great numbers in a hymenial layer. The simplest ascus fruits are angiocarpous. In the more highly differentiated Pyrenomycetes they have a special ostiolum. In another series of forms, i. e., Hysteriaceæ and Discomycetes, the fruit body may be called gymnocarpous, being closed at first but afterward open. Of much importance in the Carpoasci are the accessory fruit forms. In addition to ordinary free conidia and chlamydospores, there are conidia which have reached a higher grade of development, being produced within special fruit bodies resembling ascus fruits (the pycnidia). Still another fruit form is possible in this group, but has not been found, viz, ordinary sporangia. The simplest form of conidia appears in the Taphrineæ, being developed directly from the ascospore, even before its escape from the ascus, or else from another conidium. The next advance is the production of a germ tube on which

the conidia are borne. From this it is but a short step to mycelium, bearing conidia anywhere on its surface, a common occurrence in the Carpoasci. From simple forms like these the conidial development can be traced through coremia and more complex stroma-beds into its highest specialization, the closed fruit bodies known as pycnidia. Pycnidia are symphogenetic or meristogenetic according as they are pseudoparenchymatous, i. e., developed from a hyphæ complex, or produced by ordinary cell division, a common method in many cases. Between these two extremes are numerous intermediates. Free conidiophores, as well as conidial fruits, bear, as a rule, only one sort of spores, but sometimes, as in Diaporthe, the last produced may be of a different shape from the first. Succedaneous spore formation is regarded as a lower type than simultaneous, because the latter is more restricted. Chlamydospores appear in the Carpoasci in two forms, viz, as true chlamydospores and as oidia, but neither one is very common. Although the ascus is the highest type of fructification in this group, it is relatively the rarest. Often the fungus reproduces itself for many generations without developing asci, and for this reason many conidia and chlamydospores have been classed among the *fungi imperfecti*, the free conidiophores, as Hyphomycetes; the conidia beds as Gymnomycetes; and the pycnidia as Sphæropsidiæ, Cytisporaceæ, and Phyllostictaceæ. In many cases an exact determination of their place in the natural classification is possible only when identical forms are obtained from ascospores by artificial cultures, but the constant occurrence of two forms together renders their genetic connection probable. A great number of the Carpoasci live parasitically on algæ, forming lichens. The most of these are Pyrenomycetes and Discomycetes. In some lichens the alga forms the greater part of the thallus; in others, the fungus. Ascending from simple to complex forms, the Carpoasci are classified into (1) Gymnoasci, (2) Perisporiaceæ, (3) Pyrenomycetes, (4) Hysteriaceæ, (5) Discomycetes, and (6) Helvellaceæ. Sixty-five pages are devoted to the Hemiasci and Ascomycetes, each one pregnant with new views or interesting observations; but some of the most important statements are to be found in the last part of the book, dealing with the second or conidial series of the higher fungi. Here divergence from earlier views of classification is the most pronounced.

This series fruits exclusively by conidia. Beginning with certain Zygomycetes, the evolution of the conidial fructification can be traced step by step through the Hemibasidia into the Basidiomycetes, where it reaches the highest stage of development by the conversion of the indefinite conidiophore into the definite basidium. Chlamydospores occur in the Hemibasidia as well as in the Hemiasci, but while in the Protomycetaceæ the chlamydospores always grow out into a sporangium; in the Hemibasidia they grow out exclusively into conidiophores. All Hemibasidia have two kinds of spores, conidia and chlamydospores. The latter are constant and are the most striking spore forms, which is

also true in Protomycetes. The chlamydospores produce a sporophore, as in Chlamydomucor, but while it is accidental there, it is constant here, and while there it is a sporangiophore, here it is a basidium-like conidiophore. This intermediate group connecting Zygomycetes with Basidiomycetes separates naturally into two sub-groups, Ustilagineæ, with septate conidiophores (promycelia) bearing conidia chiefly on their sides; and Tilletiæ, with undivided conidiophores (promycelia) bearing the conidia in a whorl at the apex.

The Basidiomycetes are a very large group, rich in forms. Their most important character is the possession of basidia. The basidium is a conidiophore, which has become definitely restricted in shape, size, and the number of its spores. While an ordinary conidiophore produces spores one after another, indefinitely, from any suitable part, the basidium produces only a definite number of spores, only once, and in a particular place, and after their separation it shrivels. There is also less variation in the size and shape of the individual spores. Only in rare cases do the basidiospores become several-celled before their separation from the basidium, and this, as in similar cases elsewhere, is to be looked upon simply as an anticipation of germination phenomenon. Most basidia bear 4 spores; rarely they bear 2, 6, or 8 spores. These variations may all occur in the members of a single genus, e. g., Hypochnus. As a rule the basidiospores are borne on comparatively long sterigmata. Like the Hemibasidia, the Basidiomycetes are separable into two corresponding, but more highly developed groups. In order that the basidium-like conidiophore of the Ustilagineæ shall become a true basidium, its septa must be limited to a definite number, the position and number of sterigmata must also become definite, and finally only a single spore must be abjuncted from each sterigma. This is exactly what occurs in the Protobasidiomycetes, the first of the two subdivisions. The second and higher group consists of the true or Autobasidiomycetes, corresponding to the Tilletiæ; i. e., they have nonseptate basidia, but bear a definite number of basidiospores. In contrast to the Ascomycetes, naturally separable into Exoasci and Carpoasci, the formation of the fruit body in the conidial series is of secondary importance. Both Proto and Auto basidiomycetes begin with acarpous fruits, and from these have been developed the more highly organized forms having fruit bodies. The Protobasidiomycetes, or fungi having a septate basidium, are separable into four distinct groups: (1) Uredineæ, having horizontally septate basidia, always free, never borne in fruit bodies, and always produced from a chlamydospore (teleutospore); (2) Auriculariæ, with basidia resembling Uredineæ, but gymnocarpous, i. e., having fruit bodies which from the beginning form open hymenia; (3) Pilacreæ, which also have horizontally septate basidia, but angiocarpous or closed fruit bodies; (4) Tremellineæ, having vertically divided basidia borne in gymnocarpous fruits. The Uredineæ are especially rich in chlamydospore forms; teleutospores, uredospores, and æcidiospores are all types of this form.

The Autobasidiomycetes have undivided basidia, which bear spores only on their apex. The Hymenomycetes make up the bulk of this group and appear to have been derived from Tilletia-like forms, while the Dacryomycetaceæ have genetic relationships with the Tremellineæ, and the Gasteromycetes with the Pilacreæ, to which they are closely connected by Tylostoma. The basidia, however, in this great group are so similar that some other means of classification must be resorted to, and this is found in the fruit body. Proceeding from lower to higher, the group is divisible into (1) Dacryomycetes, with basidia split downward into two forks, but not septate; (2) Hymenomycetes, with short cylindric or club-shaped simple basidia, bearing usually 4 spores on delicate sterigmata, and having a variable but always finally gymnocarpous or only semi-angiocarpous fruit body; (3) Gasteromycetes, with basidia borne inside of various sorts of angiocarpous fruit bodies; (4) Phalloideæ, having the basidia borne during the early stages in a closed fruit body and subsequently pushed up through this and exposed to the air on a rapidly elongating sporophore.

The Dacryomycetes have also ordinary conidia and oidia. The simplest Hymenomycetes, the Tomentelleæ, are destitute of a fruit body, and the more complex forms appear to have originated from these. Next come the gymnocarpous Thelephoreæ and Clavariæ; then the hem angiocarpous forms, bearing the hymenium on the under surface of the pileus, on spines in Hyduei, on the walls of pores in Polyporei, and on lamellæ in Agaricineæ. The Polyporei are mostly poor in accessory fruit forms, but oidia occur in some species of Polyporus, Dædalea and Lenzites, while Heterobasidion (*Polyporus annosus*) bears ordinary conidia, and Oligoporus and Fistulina bear chlamydospores, the former very abundantly. The genus Oligoporus was formerly described under Polyporus, and its chlamydospores were supposed to be something entirely different and were put into the form-genus Ptychogaster. In this genus Oligoporus, the formation of chlamydospores occurs in essentially the same manner as in *Chlamydomucor racemosus* or in a Ustilago. Various Agaricineæ produce sclerotia and rhizomorphs, but no ordinary conidia have been found. It must be remembered, however, that a great many forms have not been studied critically. Oidia, on the contrary, occur in many genera and are specially abundant in the genus Nyctalis. Chlamydospores are also abundant in this genus, and may occur even in the hymenial layer, but have not been discovered in other genera.

In Gasteromycetes the fruit body is not only angiocarpous in early stages, like that of many Hymenomycetes, but remains so. The simplest forms connect directly with the angiocarpous Protobasidiomycetes (Pilacreæ). Accessory fruits (oidia) are known so far only for the Nidulariaceæ. The basidiospores of most Gasteromycetes do not germinate immediately, and consequently there is a difficulty in the way of studying this group in artificial cultures. For this reason, we know them only in the mature state and in stages leading directly up to this. Pro-

ceeding from simple to complex, the Gasteromycetes are subdivided into (1) Tylostomeæ, (2) Sclerodermiæ, (3) Lycoperdiaceæ, (4) Hymenogastreæ, (5) Nidulariaceæ, (6) Sphæroboleæ.

The Phalloideæ constitute a highly specialized group. In all of them a hymenophorous-chambered tissue, the gleba, develops within a closed envelope, the volva, which is ruptured at maturity by the upward pressure of a rapidly elongating special sporophore, the receptacle. This bears on its surface the one-celled basidia, which in turn bear the spores at their apex on very short sterigmata. Most species are tropical and not well known. The group is divided into (1) Clathraceæ and (2) Phalloideæ.

The book is dedicated to Dr. Brefeld, and ends, as it begins, with a general discussion of the relationships of fungi and a scheme of classification, which is here reproduced.

VON TAVEL'S OUTLINE OF A NATURAL SYSTEM OF THE FUNGI.

I.—ALGA-LIKE FUNGI.

Phycomycetes, with a one-celled thallus and sexual organs.

Class I.—Oomycetes. Sexual fructification in oospores; nonsexual in sporangia and conidia.	1. Monoblepharideæ.	Antheridia and oogonia in the form of sporangia; nonsexual sporangia.
	2. Peronosporeæ. Ancylisteæ. Saprolegniaceæ. ?Chytridiaceæ.	Antheridia reduced; oogonia as sporangia; nonsexual sporangia or conidia.
	3. Entomophthoreæ.	Both antheridia and oogonia reduced; nonsexual conidia.

Class II.—Zygomycetes. Sexual fructification in zygospores; nonsexual in sporangia and conidia.	1. Exosporangia.	1. Mucorineæ. Thamnidiæ.	Sporangia only.
		2. Choanephoreæ.	Sporangia and conidia. *
		3. Chætocladiaceæ. Piptocephalideæ.	Conidia only. * *
	2. Carposporangia. * * *	4. Rhizopeæ. Mortierellaceæ.	

II.—HIGHER FUNGI.

With septate thallus and without sexual organs.

MESOMYCETES.

(Intermediate forms connecting with the lower fungi through the Zygomycetes. Group relationships are indicated by asterisks, etc., corresponding to the termini of lines used by von Tavel.)

Class III.—Hemiasci. Fructification by sporangia and conidia; sporangia asci-like.	I. Exo-hemiasci.* †	1. Ascoideae. Protomycetes.
	II. Carpohemiasci. * * * † †	2. Theleboleæ.
Class IV.—Hemibasidia. Fructification by conidia: no sporangia; conidiophores basidia-like. * *	1. Ustilagineæ.† † †	Conidiophores Protobasidia-like.
	2. Tilletiæ. † † † †	Conidiophores Autobasidia-like.

MYCOMYCETES.

Class	Subclass	Orders
Class V.—Ascomycetes. Fructification by sporangia and conidia; sporangia determinate, i. e., asci.	I. Exoasci. † Asci free.	1. Endomycetes. Taphrineæ.
	II. Carpoasci. † † Asci in fruit bodies.	2. Gymnoasci. Perisporiaceæ. Pyrenomycetes. Angiocarpous.
		3. Hysteriaceæ. Discomycetes. Helvellaceæ. Hemiangiocarpous.
Class VI.—Basidiomycetes. Fructification by conidia; no sporangia; conidiophores determinate, i. e., basidia.	I. Protobasidiomycetes. † † † Basidia septate.	1. Uredineæ. Auriculariæ. Gymnocarpous.
		2. Pilacreæ.§ Angiocarpous (in both groups the basidia are divided crosswise).
		3. Tremellineæ.§ § Basidia divided lengthwise, gymnocarpous.
	II. Autobasidiomycetes. † † † † Basidia not septate.	4 Dacryomycetes. Gymnocarpous.§ §
		5. Gasteromycetes. Phalloideæ. Angiocarpous.§
		6. Hymenomycetes. Gymnocarpous and hemi-angiocarpous.

The book certainly deserves a wide reading, and students who are not thoroughly familiar with German will be glad to know that an authorized translation into English is now in preparation and may be expected during the year.—ERWIN F. SMITH.

WARD, H. MARSHALL. *The Diseases of Conifers.* <Jour. Royal Hort. Soc., vol. XIV, Oct., 1892, London, pp. 124–150 (in report of the conifer conference held at Chiswick Gardens, October 7 and 8, 1891).

This pleasant, popular paper discusses two classes of diseases, those due to fungi and those due to disturbing actions of the inorganic environment. The pines, firs, larches, junipers, and other conifers are taken up seriatim. Most of the facts presented have already been recorded, but for the general reader the paper has the great advantage of bringing together the scattered literature and presenting the main facts in a salient, suggestive way.

The premature shedding of pine needles is ascribed to several distinct causes: (1) Sharp frosts or nights so cold that the still tender foliage is chilled beyond recovery; (2) active transpiration when drought has removed the moisture from the soil, or in warm, sunny weather when the ground is frozen hard; (3) the action of various fungi, e. g., *Hysterium pinastri*, which is said to be one of the most prevalent and difficult to deal with.

Some general remarks on nonparasitic diseases of pines are worth quoting in full on account of their suggestiveness, but we must be content with the following:

> Speaking generally, the pines require light, open, and well-drained soils, as deep as possible, and many aspects of disease are due to the nonfulfillment of these conditions.
>
> Unquestionably one of the worst of these dangers results from clogging of the soil at the roots, whether due to wet clay, stagnant water, the covering up or hardening of the surface, e. g., by means of pavements, etc., or other processes.

The general course of events is much the same in all these cases. The primary cause of the injury is want of oxygen at the roots.

Of all the subaerial agents which damage pines, however, none are perhaps more to be feared than the acid gases of our larger manufacturing towns. Sulphurous acid, hydrochloric acid, chlorine, coal gas, and such like chemicals are fatal to pines, even in very small quantities, and it is no doubt to these rather than to the increased percentage of carbon dioxide, soot, or to the diminished light, that the foggy exhalations of large towns owe their enormous power for evil. Nor can we wonder at this when we reflect that many pines are mountain species, growing normally in those purest of atmospheres, which attract us for the very reason of their purity.

Considerable space is devoted to *Nectarina cucurbitula*, to the larch canker (*Peziza*), and to the latest views concerning Uredineous parasites. The European larch is said to be an alpine plant, and most of its diseases affecting it when under cultivation are primarily attributable to the unsuitable environment of lowland regions, especially to the earlier springs.

In this country the diseases of the larch are almost all initiated by late frosts, damp soil, insufficient sunlight, and alternations of periods of drought with periods of excessive moisture, in varying degrees of combination. Late frosts, or chills which approach such, are among the most deadly agents. The tender tufts of bright green foliage, to which the larches owe their spring beauty, are usually forced out in the country a month or six weeks too soon. Once they get well over this early dilatory period of sprouting, all is safe; their safety is insured in their mountain heights (1) by their not beginning to awake from the long winter rest till danger of frosts is practically over, and (2) by the extreme rapidity with which they run through the period of tenderness.

The germinal hyphæ of *Peziza willkomii* will not penetrate the sound cortex of the larch, but a slight frost injury or other wounds enables them to do so.

Trametes radiciperda " attacks the living roots of *Pinus sylvestris*, *P. strobus*, and others, sending its snow-white mycelium beneath the cortex, and traveling thence up the stem to finally penetrate the wood by way of the cambium and medullary rays. The rotting of the wood rapidly follows, with symptoms so peculiar that the presence of this fungus can be concluded with certainty from them." The author says that *T. radiciperda* is "now known very thoroughly from the recent magnificent researches of Brefeld,"* but cites Hartig to the effect that "moats, dug so as to cut off sound trees from infected ones, have been of service."

Agaricus melleus, though a less pronounced parasite, is not less destructive; the details of its action on the timber are different and its mode of spreading from root to root in the soil, by means of its long purple-black, cord-like mycelial strands, called *Rhizomorpha*, also differs. But the net results are much the same in both cases. Very tangible signs of the presence of *Agaricus melleus*, in the absence of the tawny yellow toadstools, are afforded by the copious outflow of resin from the diseased roots and base of the stem of the affected trees, and by the above rhizomorphs in the rotting wood and soil around.

Most of the *Polypori* mentioned are decidedly wound fungi, that is to say, they

* Brefeld's own conclusions in this connection are as follows: "Open isolation moats do not offer the least hindrance to the spread of this fungus, but, on the contrary greatly favor it, by breaking the diseased roots and inducing the formation of an unusual number of spore-bearing organs (see Untersuchungen, Heft VIII, pp. 182–184).

only attack successfully those parts of the timber which are already dead and exposed to the air; their influence for evil should not be underrated on that account, however, for although they are saprophytes living on the wood, their entrance into the trunk and branches means more or less rapid hollowing of the heart wood (thereby rendering the tree liable to be thrown by winds, etc.) and the gradual production of injurious substances which soak into the sound parts and pave the way for the advance of the destroying mycelium into living organs. Hence, though such fungi are saprophytes, strictly speaking, in their local action, they nevertheless act toward the whole tree taken as an individual as parasites which may induce dangerous diseases.

Remedial measures are, of course, to be directed to the careful tending and covering of wounds, a mode of procedure which has long been carried out on various trees at Kew and with decided success, I believe.

This last is a remark which American street and park commissioners and orchardists might well take to heart.

Prof. Ward happily avoids the fault of many popular writers. There is no effort to conceal ignorance or gloss over difficulties. At every turn the reader is informed of the present limitations of knowledge and of the necessity for further study. Concerning American fungi he writes as follows:

Farlow and Seymour give a long list of American forms [on the pine] that will necessitate much careful investigation before we can determine which are truly parasitic and which are saprophytic.

After giving Klebahn's recent conclusions, he says:

Several other forms of *Peridermium* are known on various species of pines. The following have hitherto been included with the above under the common name *P. pini*, but no one will now be so bold as to retain them until further investigations have decided as to their relationships. The forms in question occur on the cortex of *Pinus montana* (Mill.), *P. uncinula* (Ram.), *P. maritima* (Mill.), *P. polepensis* (Mill.), *P. mitis* (Mchx.), *P. taeda* (L.), *P. ponderosa* (Dougl.), *P. rigida* (Mill.), *P. insignis* (Dougl.), *P. sabineana* (Dougl.), *P. contorta* (Dougl.), and some other American pines, as well as on the leaves of the Indian *P. longifolia* (Lamb), and of the American *P. australis* (Mchx.).

Agaricus melleus is recorded by Farlow as occurring on *Chamæcyparis sphæroides* (Spach), and the same authority mentions *Botrytis vulgaris* on Sequoia; whether these are parasitic I do not know, and in fact the whole of the very long list of conifer fungi wants careful overhauling before we can decide as to their share in producing diseases.

Finally, after calling attention to Asterina, Meliola, Coryneum, Dothidea, Pleosporæ, Sphærella, Stigmatea, etc., Prof. Ward makes the following very pertinent remarks:

With regard to a large number of these forms, and to even more numerous foreign forms, we are as yet quite in the dark as to whether they are parasites or not.

Experience warns us, however, that in many cases epidemic fungous diseases suddenly force themselves on our attention, owing to some form hitherto occurring sparsely and known only to the curious expert, having become suddenly favored in its struggle for existence. I have already given you several examples, notably that of the larch disease, into the life struggles of which we have succeeded in peering rather deeply. Surely such considerations should alone suffice to extend and cement the sympathy between the practical horticulturist and the persistent though perhaps unobtrusive investigator, which, I am happy to see, is becoming more and more pronounced as each understands better the ways and high aims of the other.—ERWIN F. SMITH.

ERRATA TO INDEX TO LITERATURE.

The following corrections and additions should be made in the numbers of the ndex:

No. 55. *Should read,* vol. I, No. 3, May, 1890.

No. 81. *Add* (see also Texas Agr. Exp. Sta. Bull. No. 7, Austin, 1890, pp. 30, pl. 5).

No. 82. *Add* vol. VII, p. 293, 1 col.

No. 83. *Add* vol. VII, p. 259, 1 col.

No. 84. *Add* vol. VII, p. 198, figs. 4.

No. 95. *Add* pp. 235–259, figs. 8.

No. 116. *Add* (see also Orange Judd Farmer, vol. VIII, Oct. 4, 1890, p. 213, figs. 3).

No. 119. *Add* (see also Orange Judd Farmer, vol. VIII, Dec. 20, 1890, p. 387, 2 cols., igs. 6).

No. 157. *Add* (see also Orange Judd Farmer, vol. VIII, Oct. 25, 1890, p. 259).

No. 169. *Add* (see also Phila. Acad. Nat. Sci., Proc. for 1890, Part I, Jan.–Mar., 1890, pp. 36–37).

No. 214. *Should read,* Ann. Rept. Cal. State Board Hort. for 1890, Sacramento, 1890, pp. 242–249.

No. 223. Reference *should read,* Ann. Rept. Cal. State Board Hort. for 1890, Sacramento, 1890, pp. 169–177.

No. 331. *Add* (see also Exp. Sta. Bull. No. 7, Washington, 1892, pp. 101–104).

No. 357. *Add* (see also Orange Judd Farmer, vol. VIII, Oct. 11, 1890, p. 226).

No. 362. *Add* (see also Ann. de l'École Nat. d'Agr. de Montpellier, t. VI, for 1891, 1892, pp. 156–171).

No. 378. *Add* (see also Bot. Gaz., vol. XVII, Jan. 20, 1892, pp. 17–18).

No. 416. *Add* (see also Exp. Sta. Rec., vol. III, Feb., 1892, p. 445).

No. 422. *Add* p. 71.

No. 435. *Add* (see also Ann. de l'École Nat. d'Agr. de Montpellier, t. VI, for 1891, 1892, pp. 5–116, pl. 6).

No. 437. *Add* (see also Ann. de l'École Nat. d'Agr. de Montpellier, t. VI, for 1891, 1892, pp. 152–155, pl. 1).

No. 458. *Add* (see also Exp. Sta. Rec., vol. II, Apr., 1891, p. 491).

No. 459. *Add* (see also Exp. Sta. Rec., vol. III, Oct., 1891, pp. 144–145).

No. 507. *Add* (see also Exp. Sta. Rec., vol. III, Oct., 1891, p. 172).

No. 531. *Add* (see also Bull. Soc. Mycol. France, vol. VIII, Mar. 31, 1892, pp. 13–19).

No. 680. *Add* (see also Prairie Farmer, vol. LXIV, Apr. 9, 1892, p. 230).

No. 698. *Add* (see also Prairie Farmer, vol. LXIV, Aug. 20, 1892, p. 530).

No. 702. *Add* (see also Orange Judd Farmer, vol. VIII, Dec. 20, 1890, p. 387, 2 cols., figs. 6).

No. 703. *Instead of* C[HURCHILL, G. W.] *read* [BEACH, S. A.].

No. 710. *Add* (see also Gard. Chron., 3d ser., vol. X, July 18, 1891, p. 68).

No. 755. *Add* (see also Exp. Sta. Rec., vol. III, June, 1892, p. 783).

No. 780. *Add* (see also Am. Florist, vol. VI, Nov. 1, 6, 1890, pp. 150, 166).

No. 800. *Add* (see also Gard. and Forest, vol. V, Feb. 10, 1892, p. 72).

No. 876. *Add* (see also No. 531, and Bull. Soc. Mycol. France, vol. VIII, Mar. 31, 1892, pp. 13-19).

No. 885. *Add* (see also Rev. Mycol., vol. XIV, July, 1892, pp. 101–102).

No. 970. In line 18 *instead of* "referred to the following species" *read* referred to *Uromyces anthyllidis.* In line 29 *instead of* "of the latter" *read* of *U. hedysari* (DC.) Fckl."

INDEX TO LITERATURE.

In the following index all articles from foreign sources are indicated by the numbers prefixed being in bold-faced type. All those having numbers in the ordinary type relate to American literature.

A.—WORKS OF A GENERAL NATURE.

1003. [ANON.] **Potato-blight gauge.** <Ann. Rept. Sec. for Agr., Nova Scotia, for 1890. Halifax, 1891, p. 73.

Gives a table showing relation of temperature to increase of blight. There will be no blight at 30° F. Its optimum is 72°, and the blight dies at a temperature of 77° F. (J. F. J.)

1004. [ANON.] **Practice vs. theory.** <Pacific Tree and Vine, vol. IX, San José, Cal., Mar. 21, 1892, p. 5, 1 col

Refers to statement made by Mr. E. Smith at Stanford University, that Tahite orange stock is best adapted for use in California. In refuting this, quotes from W. A. Saunders to the effect that foot rot is very prevalent in Tahite stock. This writer also recommends *Citrus trifoliata* as a hardy Japanese stock, admirably adapted to resist cold, and free from disease. (J. F. J.)

1005. BAIRD, DAVID. **American Pomological Society.** <Proc. N. J. State Hort. Soc., 17th meeting, Newark, 1892, pp. 21-25.

Mentions the papers read before the meeting, referring to one by Galloway on losses from fungous diseases in 1890—from apple scab amounting to $16,000,000, and from diseases of pears, plums, etc., amounting to not less than $50,000,000 annually. Notes remarks of Erwin F. Smith on peach yellows, giving as the conclusions reached that the disease is not caused by soil exhaustion; that it can not be cured by fertilizers; that the only remedy is destruction of diseased trees; that a healthy tree can be grown where a diseased one has been; and that the disease is increasing. (J. F. J.) [The text says "can not be grown." This is an error.]

1006. BOUDIER, [E.] **Notice sur M. Roumeguère.** <Bull. Soc. Mycol. France, vol. VIII, May 22, 1892, p. 70.

Casimir Roumeguère died Feb. 29, 1892, in his sixty-third year. He was the author of a considerable number of works, some of which, especially "Revue Mycologique," secured him a great reputation. His "Cryptogamie illustrée," "Flore mycologique de Tarn-et-Garonne," and finally "Fungi gallici exsiccati" occupy a prominent place in mycological literature. (T. H.)

1007. BOURQUELOT, EM. **Champignons desséchés falsifiés avec des morceaux de navet.** <Bull. Soc. Mycol. France, vol. VIII, Paris, Mar. 31, 1892, p. 39.

Alessandri (Zeitsch. f. Nahrungsm.-Untersuch. u. Hyg., 1891, p. 79) has examined some articles supposed to be dried mushrooms, but the appearance and odor did not correspond to the organisms they were said to be. They were simply turnips, cut into pieces and dried. (T. H.)

1008. BOURQUELOT, EM. **Les champignons au marché d'Iéna en 1891.** <Bull. Soc. Mycol. France, vol. VIII, Paris, Mar. 31, 1892, pp. 38-39.

Dr. Em Pfeiffer (Aufsicht des Pilzverkaufs, in Apothekerzeitung, 1891, p. 563) enumerates the mushrooms that have been offered for sale in the market of Jena. There were two varieties of *Psalliota campestris*, viz, *vaporaria* and *silvicola*; also *Marasmius scorodonius*, *Boletus edulis*, and by mistake *Boletus felleus* and *Russula fœtens*. (T. H.)

1009. COLENSO, W. **Plain and practical thoughts and notes on New Zealand botany.** <Trans. and Proc. New Zealand Inst., ser. 7, vol. XIV, Wellington, May, 1892, p. 403.

Notes that a few of the New Zealand fungi were articles of food with the ancient Maoris, but the principal edible one, *Hirneola polytricha*, has long been a commercial article, as much as 339 tons, valued at £15,581, having been collected in the forests in one year for the Chinese market. (T. H.)

1010. COOKE, M. C. **Plant diseases and fungi.** <Essex Nat., vol. VI, Essex, Jan.-Mar., 1892, pp. 18-31.

Refers to the injury caused by fungi to crops, especially cereals and apples. Notes the spread of diseases, like those of the potato and hollyhock, and mentions diseases caused by microorganisms. Peach yellows and California vine disease are especially mentioned. Refers to experiments by Halsted on cultivation of fungi, and inoculation of diseased melons. Advocates the treatment of diseases of plants with fungicides. (J. F. J.)

1011. CONSTANTIN, JULIEN. **Note sur un cas de pneumomycose observé sur un chat.** <Bull. Soc. Mycol. France, vol VIII, May 22, 1892, pp. 57-59.

Describes some obscure organisms, consisting of large and small spores, which were found in the trachea of a cat that had died from suffocation. Two kinds of spores were found, the larger possibly belonged to a *Mortierella*, and probably represents a new species. The smaller spores may represent a species of *Mucorineæ*. (T. H.)

1012. CROOKS, WM. **Some possibilities of electricity.** <Fortnightly Rev., n. ser., vol. LI, London, Feb., 1892, pp. 173-181.

Contains a few lines about fungi. States that "electric currents not only give increased vigor to the life of higher plants, but tend to paralyze the harmful activity of parasites, animal and vegetable." Estimates the loss to Great Britain by insects and fungi at £12,000,000 per annum. Says we have yet to decide whether electricity can be made beneficial to our crops either directly or by preventing fungi. (M. B. W.)

1013. DUDLEY, W. R. **Report of the cryptogamic botanist.** <Third Ann. Rept. Cornell Univ. Agr. Exp. Sta. (for 1890), Ithaca, N. Y., 1891, pp. 29-34, fig. 1.

Describes the laboratory and the methods of work, with general mention of the work carried on during the year (see also Exp. Sta. Rec., vol. II, Apr., 1891, pp. 501-502). (J. F. J.)

1014. [EDITORIAL.] **Fruit diseases in Congress.** <Orange Judd Farmer, vol. XI, Chicago, Mar. 19, 1892, p. 181, 1 col.

Gives text of bill introduced into House of Representatives to prohibit interstate transportation of diseased nursery stock, vines, etc. Considers the present form of the bill unwise because of difficulty of determining the presence of diseases. Believes restricting the sending of nursery stock from regions known to be affected would be a good plan, but even this has objections. Does not believe at all in the bill in its present form. (J. F. J.)

1015. [EDITORIAL.] **Get rid of the deposit.—The board of health on the grape question.** <Daily Times, New York, Sept. 27, 1891.

Gives abstracts of remarks by B. T. Galloway on the Bordeaux mixture, before the New York board of health, and the resolutions adopted by the board and the Chamber of Commerce. (J. F. J.)

1016. [EDITORIAL.] **Good news for nurserymen and fruit-growers.** <Geneva [N. Y.] Advertiser, May 5, 1891.

A statement of work to be carried on at the New York Agricultural Experiment Station, under the auspices of the Department of Agriculture, for the treatment of fungous diseases of apple, pear, quince, cherry, plum, and peach. Mentions the number of stocks and the contributors of each. Gives a summary of the problems to be investigated. Refers also to prospective treatments for apple scab at Brockport. (J. F. J.)

1017. [EDITORIAL.] **[Work on plant diseases by the Department of Agriculture.]** <Farm and Home, Wilmington, Del., May 8, 1890.

Refers to work of Division of Vegetable Pathology in investigation of peach yellows, pear leaf-blight, and scab. The two latter can be controlled by the use of fungicides. (J. F. J.)

1018. FISCHER, A. **The importation of vine cuttings to Austro-Hungary.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Oct. 8, 1891, p. 85, ½ col.

Notices the action of the Austro-Hungarian Government in prohibiting the importation of cuttings and even vine seeds from the United States. Considers the prohibition too sweeping. (J. F. J.)

1019. HALSTED, B. D. **What the station botanists are doing.** <Bot. Gaz., vol. XVI, Crawfordsville, Ind., Oct. 16, 1891, pp. 288-291.

A general statement of the work of botanists at 22 different agricultural experiment stations. Most of these are doing mycological work (see Exp. Sta. Bull. No. 7, U. S. Dept. of Agr., Washington, 1892, pp. 17-19, under heading of Report of the Section of Botany of the Association of American Agricultural Colleges and Experiment Stations). (J. F. J.)

1020. HARRINGTON, MARK W. **Meteorological work for agricultural institutions.** <Exp. Sta. Bull. No. 10, U. S. Dept. Agr., Washington, Feb. 3, 1892, pp. 23.

On p. 16 states desirability of making observations on the appearance of fungous diseases of plants when dependent on weather conditions. By observing these, predictions might be made as to the appearance of plant diseases. (J. F. J.)

1021. KLEBAHN, H. **Ueber Pflanzenkrankheiten und deren Bekämpfung.** Bremen, 1892, pp. 11.

A popular sketch of plant diseases and their remedies. *Peridermium strobi* seems to be dreaded in Germany, and it is recommended not to keep *Pinus strobus* in cultivation together with native or imported species of *Ribes*. No remedy is known. The author recommends the hot-water treatment as most successful against smut in the cereals, and describes this and other kinds of treatments. (T. H.)

1022. [MAYNARD, S. T.] **The amount of copper on sprayed fruit.** <Mass. Hatch Agr. Exp. Sta. Bull. No. 17, Amherst, Apr., 1892, pp. 38–40.

Gives a short account of analyses made of grapes and apples to ascertain the amount of copper on the fruit. On one sample of the former 0.002 of 1 per cent was found and on another no trace whatever. On one peck of apples there was 0.022 of a grain of copper, this amount requiring about 2,000 barrels of apples to yield an ounce of the copper oxide. (J. F. J.) See also *Science*, vol. XIX, May 13, 1892, pp. 275–276, under title "Is it dangerous to spray fruit trees with solutions of poisonous substances in order to prevent depredations from destructive insects?"

1023. MCALPINE, D. **Report of the vegetable pathologist.** <Dept. of Agr. Victoria, Bull. No. 12, Melbourne, July, 1891, pp. 59–60.

Gives a general outline of the work to be undertaken by the Government in investigating plant diseases. (J. F. J.)

1024. NEALE, A. T. **[Introduction to report of F. D. Chester on fungicides for grape diseases.]** <Del. Agr. Exp. Sta. Bull. No. 10, Newark, Oct., 1890, pp. 3–7.

Mentions the results obtained by treatment of vine diseases in the increased money value. Notes that leaving unsprayed rows in the center of a vineyard tends to decrease the real value of spraying. The unsprayed vines should be outside of all the good influences of the sprayed ones in order to obtain an accurate knowledge of the value of the fungicide. Notes also that anthracnose can be held in check by Bordeaux mixture and by carbonate of copper. Argues in favor of using a spray of vinegar to clear grapes of deposit of copper, should it be conspicuous (see Exp. Sta. Rec., vol. II, U. S. Dept. of Agr., Washington, July 1891, pp. 712–713.) (J. F. J.)

1025. NEALE, A. T. **[Report of the director of Delaware Agricultural Experiment Station.]** <Third Ann. Rept. Del. Agr. Exp. Sta. for 1890 [Newark], 1891, pp. 7–24, figs. 4.

Refers to the diseases of plants investigated by Prof. Chester and mentions the practical results of the work in orchards and vineyards. Mentions also investigations made on diseases of various field crops. On page 23 refers to studies on copper on grapes and in potatoes. Analyses of the former show about 47 pounds of metallic copper in 1,000,000 pounds of grapes. In potatoes the pulp showed from 1.26 to 1.33 pounds of copper per 1,000,000 pounds, while the skin showed from 16 to 40 pounds in 1,000,000 (see Chester, F. D., and Penny, C. L.). (J. F. J.)

1026. PENNY, C. L. **Report of the chemist.** <Third Ann. Rept. Del. Agr. Exp. Sta. for 1890 [Newark], 1891, pp. 129–154.

On pp. 149–150 discusses copper on grapes and concludes that it is not injurious. The tongue is as safe a guide as anything else, as with 47 parts in one million a distinctly metallic taste is perceived; this proportion is the same as that of beef liver. On p. 154 discusses the absorption of copper from the soil, and notes that potatoes absorb it to a limited degree and that it is mainly stored up in the rind of the tubers. These contain from 16 to 40 parts per million, the latter grown in a soil known to be rich in copper. (J. F. J.)

B.—DISEASES OF NONPARASITIC OR UNCERTAIN ORIGIN.

1027. [ANON.] **Peach trees with diseased branches.** <Gard. Chron., 3d ser., vol. IX, London, Apr. 14, 1891, p. 473, ⅛ col.

Refers to an obscure disease due perhaps to overrich soil. Notes that knife pruning frequently causes gumming, and gives as a cure semi-starvation of roots and trimming by removing by the finger and thumb branches not wanted. (J. F. J.)

1028. [ANON.] **Peach yellows.** <Gard. and Forest, vol. IV, New York, Feb., 1891, p. 84, ⅛ col.

Notes decrease of disease in Michigan, but increase in Maryland. Argues from this that benefits are likely to result from enforcement of laws against the disease. States that no cure is as yet known. (J. F. J.)

1029. [ANON.] **Peach yellows.** <Gard. Chron., 3d ser., vol. XI, London, Mar. 26, 1892, p. 402, ⅙ col.

States that while the disease is unknown in England it is common in the United States. Refers to work of Dr. Erwin F. Smith, showing contagious nature of the disease. (J. F. J.)

1030. [ANON.] **"Takeall."** <Gard. and Field, vol. XVII, Adelaide, Feb., 1892, p. 182, $\frac{1}{16}$ col.; p. 186, $\frac{1}{16}$ col.

Sandy soil with clay subsoil seems to favor the disease. Caused by soil being too retentive of moisture. Insects have been observed on roots of affected plants. (J. F. J.)

1031. [ANON.] **"Take-all."** <Gard. and Field, vol. XVII, Adelaide, Feb., 1892, p. 189, $\frac{1}{16}$ col.

States that fallowed land is most subject to the disease. "Deadheads" considered a continuation of "take-all." Considerable difference of opinion was expressed in a discussion of the subject. (J. F. J.)

1032. ATKINSON, GEO. F. **Some leaf-blights of cotton.** <Ala. Exp. Sta. Bull. No. 36, Auburn, Mar., 1892, pp. 32, pl. 2.

Describes yellow leaf-blight (the same as black rust of previous papers) as a physiological disease, due to imperfect nutrition or assimilation. Gives an account of the appearance of the disease on the leaves, the injury to which may be increased by the growth of fungi under favorable conditions. Gives details of experiments with various fertilizers, especially with kainit and nitrate of soda. The former tends to prevent the disease and also to increase the crop. Gives history of kainit as a preventive, and discusses the effects of the characters of soil on the disease. "Red leaf-blight" is due to hastened maturity of the plant, caused by impoverished condition of the soil, and may be prevented by use of proper fertilizers. "Cerealite" is said to produce good results (see Exp. Sta. Rec., vol. III, July, 1892, pp. 844–845). (J. F. J.)

1033. [BERCKMANS, P. J.] **Peach rosette in the South.** <Am. Gardening, vol. XIII, New York, Dec., 1892, p. 762, ⅓ col.

Notes the spread of disease in the South, as well as its virulent nature, and recommends immediate destruction of all infected trees. Wild plums in vicinity should be destroyed, as disease appears among these first and then spreads to cultivated trees. (J. F. J.)

1034. BONET, JEAN. **Folletage ou maladie nouvelle.** <Prog. Agr. et Vit., 9th year, Montpellier, July 31, 1892, pp. 97–98.

This seems to be a new disease, which has lately appeared in the French vineyards. The leaves become dry and curl up in the form of a tube, and this takes place very suddenly, while the petiole shows an annular incision at the base of the blade or where the petiole is joined to the stem. The leaves do not drop off but remain on the trees in this abnormal position. High winds may be the cause. (T. H.)

1035. BURBERRY, W. **Disease in Cattleyas.** <Gard. Chron., 3d ser., vol. XI, London, Feb. 27, 1892, p. 276, 1 col.

Describes a disease affecting orchids which causes the pseudo-bulbs and leaves to change from green to yellow and black. In one case the diseased portions were cut from the leave, and when planted recovered. The editor recommends cutting out diseased portions and washing the wound with Condy's fluid or carbolic acid. (J. F. J.)

1036. C——, G. **Tomato disease in Teneriffe.** <The Garden, vol. XXXIX, London, June 20, 1891, p. 572, ⅛ col.

Refers to an obscure disease which causes plants to shrivel up on cold, clear nights, with dew but no wind. The plants recover when the weather becomes warm. (J. F. J.)

1037. CHARLTON, J. **Pruning and canker in fruit trees.** <Gard. Chron., 3d ser., vol. XI, London, Jan. 16, 1892, p. 83, ⅛ col.

Records curing canker by close pruning of diseased trees. (J. F. J.)

1038. CHUARD, E. **Maladie de Californie.** <Chron. Agr. du Canton de Vaud, vol. V, Lausanne, Mar. 10, 1892, p. 116.

Refers to the destructive nature of the California vine disease and notes the demand of various societies in France that the Government prohibit the introduction of vines from California and from America in general. (J. F. J.)

1039. D——, C. W. **The violet disease.** <Am. Florist, vol. VII, Chicago and New York, Jan. 14, 1892, p. 492, ⅛ col.

Notes appearance of disease on certain varieties of violets. Remedy consists in picking off affected leaves. (J. F. J.)

1040. DEGRULLY, L. **Les Tétranyques et la brunissure.** <Prog. Agr. et Vit., 9th year, Montpellier, Aug. 21, 1892, pp. 169–170.

F. Sahut claims to have discovered a new disease of grapevine, due to insects. These are red spiders (*Tetranychus*), which live upon the lower surface of the leaves, where they produce a silky tissue, rather loose in texture. The leaves attacked in this way turned yellow, faded, and soon dropped off. Viala considers this case to be a mere coincidence, since, according to him, the leaves were killed by *Plasmodiophora vitis*, although the color of the spots on the leaves was bright red, not brown, as in the "brunissure." Several correspondents state that this disease seems to start in places near the roads, where it often has been observed to remain without going farther. (T. H.)

1041. DOD, C. W. **Basal rot in daffodils.** <Gard. Chron., 3d ser., vol. X, London, Aug. 8, 1891, p. 173, ⅛ col.

Notes the presence of an obscure disease in bulbs, due, it is thought, to impaired constitutions arising from unsuitable cultural conditions. (J. F. J.)

1042. GAYLORD, EDSON. **Pruning orchard trees.** <Orange Judd Farmer, vol. XI, Chicago, Feb. 27, 1892, p. 133, ⅜ col.

Argues against too great trimming of fruit trees in the Northwest, as it renders them liable to be killed by the hot sun [sun scald]. (J. F. J.)

1043. H——, T. C. **Splitting of peaches and nectarines.** <Gard. Chron., 3d ser., vol. x, London, Oct. 24, 1891, p. 493, $\frac{1}{2}$ col.

Attributes this trouble to conditions of moisture and heat. (M. B. W.)

1044. HAMANN, VALENTINE. **Violets.** <Am. Florist, vol. VII, Chicago and New York, Jan. 7, 1892, p. 461, $\frac{1}{2}$ col.

States belief that disease is due to planting out late and to the plants being grown too delicately. (J. F. J.)

1045. HELLIER, J. B. **Peach yellows again.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Dec. 17, 1891, p. 135, $\frac{3}{8}$ col.

Refers to the article in Scientific American (see No. 366), stating that the disease is due to starvation. Does not so regard it, but believes lowered vitality may make the tree more susceptible to the disease, hence recommends the use of potash fertilizers, especially wood ashes, to keep fruit trees in good condition. (J. F. J.)

1046. HEYER, EDUARD. **Eine neue Krankheit der Eichenschälwaldungen.** <Allgemeine Forst- und Jagdzeitung, Darmstadt, Dec., 1891, pp. 438–439.

A supposed new disease has appeared upon oak trees 2 years old in plantations near Alzey, in Rhein-Hessen. The leaves show curled margins and soon fade away, and the branches die soon after. In this manner numerous trees have been destroyed, but the nature of the disease is not known. Prof. Hartig supposes that the disease is due to a fungus, the mycelium of which he claims to have discovered, but not yet described. (T. H.)

1047. HOPTON, E. **The cultivation of the peach (*Persica vulgaris*).** <Dept. of Agr. Victoria, Bull. No. 14, Melbourne, Dec., 1891, pp. 134–137.

Notes the occurrence of "yellows" in Victoria. States that he believes it was stamped out of his orchard by digging away the old and substituting fresh soil. Does not know any cure and recommends the removal of the tree when the disease has attacked it. For "curl blight" recommends, when the tree is coming into leaf, clearing the earth from the collar of the tree and watering with 1 pint of coal tar to 6 gallons of water, repeating the same when the fruit is set. (J. F. J.)

1048. LELONG, B. M. **Eastern peach yellows.** <Ann. Rept. State Board Hort. of Cal. for 1891, Sacramento, 1892, pp. 405–410, fig. 1.

Gives a statement of the wide extent and destructive character of the disease, advocates prohibiting the importation of trees from outside the State, and advises against buying trees from localities outside of California. (J. F. J.)

1049. MACOWAN, P. **Disease in peach trees.** <Agr. Jour. Cape Colony, vol. III, Cape Town, May 7, 1891, p. 201, $\frac{1}{2}$ col.

Asks peach-growers whose trees are affected by "chlorosis of the leaves, supposed to be the same disease as the American yellows," to try the effect of mixing sulphate of iron with the soil about the trunk of the trees. (J. F. J.)

1050. MACOWAN, P. **Peach yellows again.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Dec. 17, 1891, p. 135, $\frac{3}{4}$ col.

Refers to work of Dr. Erwin F. Smith, and to the statement of Meehan that *Agaricus melleus* is the cause of the disease. Quotes Sargent against this theory and argues against it himself, arguing in favor of a bacillus being the cause. Mentions a disease of the olive produced by a similar organism, and one of young blue-gum trees. Recommends the immediate destruction of the latter by fire. (J. F. J.)

1051. MACOWAN, P. **Yellows in peach trees.** <Agr. Jour. Cape Colony, vol. III, Cape Town, May 7, 1891, p. 208, $\frac{1}{4}$ col.

Refers to an article in Garden and Forest to the effect that the disease in New Jersey is caused by a species of root louse and may be cured by the application of kainit or tobacco. Questions this assertion and notes that examinations of trees in South Africa have failed to reveal any insect or insect injuries. (J. F. J.)

1052. MEEHAN, THOS. **Peach tree "yellows."** <Meehan's Monthly, vol. II, Germantown, Pa., May, 1892, p. 80, $\frac{1}{2}$ col.

Notes the fact that while peach trees have been shipped in large quantities to the South and to the Pacific coast from the Northeastern States, yellows has not appeared in either locality. Yet as soon as they were sent to Michigan and some other States the disease appeared. Queries why this should be, and refers to reasons suggested in a previous number of the Monthly (see No. 679) [i. e., because the disease is due to *Agaricus melleus* which does not occur where the disease is absent]. (J. F. J.)

1053. MEIER, HERMANN. **Yellows in peach trees and disease in hop plants.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Nov. 5, 1891, p. 105, $\frac{3}{4}$ col.

Notes the occurrence of what may be yellows and asks for information. States also that rust had appeared on hop plants. (J. F. J.)

1054. PECK, D. E. **Fruit tree sun-scald.** <Orange Judd Farmer, vol. XI, Chicago, Mar. 12, 1892, p. 164, ⅛ col.

Argues against excessive trimming of fruit trees in the Northwest, as the hot afternoon sun is liable to produce sun-scald if the top be too open. (J. F. J.)

1055. PERINGUEY, L. **Disease in orange trees.** <Agr. Jour. Cape Colony, Cape Town, Apr. 23, 1891, pp. 192–194.

Describes a disease in which the leaves become yellow, a gum exudes from the bark above the ground, and the roots when exposed give out an offensive smell. The trouble occurs in all situations, and is supposed to be due to a fungous parasite. (J. F. J.)

1056. ROBINSON, NORMAN. **The "die-back" question again.** <Fla. Disp. Farm. and Fruit Grower, n. ser., vol. IV, Jacksonville, May 5, 1892, pp. 352–353.

Considers the disease in the greater number of cases due to "ill-balanced or defective fertilization." Gives analyses of various kinds of soil, and thinks that in one case at least the cause of the disease was defective drainage of the subsoil. Believes that the application of lime to the surface and good drainage below the surface will be beneficial. (J. F. J.)

1057. TAYLER, WILL. **Cracks and spots on pears.** <Gard. Chron., 3d ser., vol. XI, Feb. 6, 1892, London, p. 180, ½ col.

Thinks that climatic influences, such as an east wind, are the most important causes of diseases of plants. In case of the pear, states that the strongest predisposing cause is a crude, infertile subsoil. In a note by the editor the appearance of injuries caused by *Fusicladium* and *Gymnosporangium* are briefly described. (M. B. W.)

1058. TEPPER, J. G. O. **"Take-all," and its remedies.** <Agr. Gaz. N. S. Wales, vol. III, Sydney, Jan., 1892, pp. 69–72.

Describes the appearance of a field affected by the disease, and notes that it has been variously ascribed to fungi, insects, frost, inefficient fertilization, etc. Sketches the general needs of plants for growth, and concludes that the disease is due to starvation. Gives instances where manuring or fertilizing had prevented it, and advocates use of manure for its prevention. (J. F. J.)

1059. VAN DEMAN, H. S. **The relative merit of various stocks for the orange.** <Div. of Pomol. Bull. No. 4, U. S. Dept. Agr., Washington, 1891, pp. 1–17.

Notes that sour stock is generally free from disease, especially *Mal di goma*, and recommends the grafting of budded stock on it rather than on sweet. Sour seedlings are affected by leaf-scab, but when budded the danger from this is over, as the disease does not affect the sweet top. Ammoniacal solution of copper recommended for trial. *Mal di goma* occurs in Louisiana among sweet seedlings, and is there known as "sore shin." In California it has been treated by cutting out diseased wood and painting with rubber paint. Sour stock is used there also. For a reprint of the article, together with notes on *Mal di goma*, by W. R. King see No. 353; also Agr. Gaz. N. S. Wales, vol. III Sydney, Feb., 1892, pp. 129–141. (J. F. J.)

1060. [VARIOUS.] **Black-knot.** <Ann. Rept. State Board Hort. of Cal. for 1891, Sacramento, 1892, pp. 431–432.

A discussion on black-knot of roots of nursery stock and grapevines, some stating the cause to be moisture, others that the trouble is due to the stagnation of sap or bursting of sap vessels. (J. F. J.)

(See also Nos. 1005, 1010, 1068, 1108, 1212.)

C.—DISEASES DUE TO FUNGI, BACTERIA, AND MYXOMYCETES.

I.—RELATIONS OF HOST AND PARASITE.

1061. BURRILL, T. J. **What are the possibilities of originating a class of pears exempt from blight?** <Proc. Am. Pom. Soc. for 1891, 23d session, 1891, pp. 66–70.

Notes the cause of blight to be a microorganism (*Micrococcus amylovorus*) and describes its general appearance and mode of growth. Believes it possible to overcome blight, and suggests testing the ability of different varieties of pears to resist blight by inoculation. (J. F. J.)

1062. C[OOKE], M. C. **Fungi on various trees.** <Gard. Chron., 3d ser., vol. IX, London, Jan. 24, 1891, p. 123, ⅛ col.

Notes that various species of Polyporei occurring on trees attack only decayed places, and not the living, healthy tissues. (J. F. J.)

1063. HALSTED, B. D. **Parasitic fungi as related to variegated plants.** <Bull. Torrey Bot. Club, vol. XIX, New York, Mar. 5, 1892, pp. 84–88.

Notes the fact that plants with variegated leaves seem more subject to the attacks of fungi than those not variegated. Gives a list of the genera of plants containing species with variegated leaves and the genera attacking each. Notes that the more widely the light spots are scattered over the leaf, the more generally the leaf is diseased. Considers it natural for variegated plants to blight, inasmuch as they are deprived of a large part of the necessary chlorophyll and are in a weakened condition in consequence (see notice in Science, vol. XIX, Mar. 25, 1892, p. 172, ½ col; also Gard. and Forest, vol. V, Mar. 23, 1892, p. 142, where the paper is reviewed and an argument advanced against the use of variegated plants as ornamental features in landscape gardening). (J. F. J.)

1064. HALSTED, B. D. **The influence upon crops of neighboring wild plants.** <Proc. N. J. State Hort. Soc., 17th meeting, Newark, 1892, pp. 110–122 (reprint 13 pp.).

Shows the interrelations between wild and cultivated plants, especially as regards the effects of fungi upon such crops as lettuce, celery, spinach, etc. Insists upon the necessity of keeping the plants healthy by proper cultivation, seeding, etc. If this be done, and then a fungicide used, its effect will be most marked (see Bot. Gaz. Apr., 1892, vol. XVII, pp. 113–118, under the title "Some fungi common to wild and cultivated plants," with a few changes in phraseology. An extract also given in Science, vol. XIX, Apr. 29, 1892, p. 24[illegible] col). (J. F. J.)

(See also No. 1223.)

II.—DISEASES OF FIELD AND GARDEN CROPS.

1065. [ANON.] **Lettuce mildew.** <Gard. Chron., 3d ser., vol. XI, London, Apr. 23, 1892, p. 534–535, ⅙ col.

Notes occurrence of *Bremia lactucæ* in market gardens near London and quotes from W. G. Smith remedy for same. (J. F. J.)

1066. [ANON.] **Potato disease.** <Agr. Gaz. N. S. Wales, vol. III, Sydney, Jan., 1892, p. 77.

Gives a statement of the general method of cultivating the potato and says that the disease caused by *Phytophthora infestans* is not known in New South Wales. (J. F. J.)

1067. ARTHUR, J. C., and GOLDEN, K. E. **Diseases of the sugar-beet root.** <Purdue Univ. (Indiana) Agr. Exp. Sta. Bull. No. 39, vol. III, La Fayette, Apr. 13 1892, pp. 55–62.

Describe a disease due to a bacterial parasite which affects in a marked degree the percentage of sugar derived from the beets. Beet scab, caused by *Oospora scabies* Thax. also described and illustrated. This disease originates from the soil and is caused by the spores lying there, derived from some previous root crop. Water core spots, the origin of which is unknown, also described (see Gard. Chron., London, June 4, 1892, p. 726; Exp. Sta. Rec., vol. III, July 1892, pp. 853–855; Agr. Sci., vol. VI., Aug. 1892, pp. 383–384; Gard. and Forest, vol. V, Apr. 27, 1892, p. 204). (J. F. J.)

1068. BAILEY, L. H. **Some troubles of winter tomatoes.** <Cornell Univ. Agr. Exp. Sta. Bull. No. 43, Ithaca, N. Y., Sept., 1892, pp. 149–158, figs. 4.

Describes "winter blight" of tomatoes, a disease affecting plants in the forcing house. This attacks the leaves and sometimes kills the plants outright. Probably caused by bacteria, but is different from the bacterial disease of potatoes. No remedy yet known, but it is recommended to remove all diseased plants as soon as observed. If disease becomes severe both plants and soil should be removed and a new start made. Common blight caused by *Cladosporium fulvum*, also described. Spraying with ammoniacal carbonate of copper is recommended. Roots of plants are also attacked by nematode root [illegible]. (J. F. J.)

1069. BEHRENS, I. **Ueber das Auftreten des Hanfkrebses im Elsass.** <Zeitsch. Pflanzenkrank., vol. I, Stuttgart, 1891, pp. 208–215.

Two fungi have been observed injuring hemp in Elsass, namely, a *Sclerotinia*, the species of which could not be ascertained, but seemed to be either *fuckeliana* or *libertiana*, and *Melanospora cannabis* sp. nov. The author examined two crops from 1890 and 1891, and several stems from the first year's collection showed the presence of *Botrytis*. No *Botrytis*, however, was observed on material of the following year's crop, although the stems showed numerous hyphæ of a fungus like those from the preceding year. By transferring this fungus upon bread, sclerotia developed very abundantly, but no *Botrytis*. The fungus proved to be a *Sclerotinia*, of which the species *libertiana* is well distinguished from *fuckeliana* by not having the *Botrytis* fructification during the mycelial stage. Further studies are necessary for the specific identification of this fungus. *Melanospora cannabis* is red and occurs upon the base of the stems of hemp. It not only flourishes upon the hemp, but also upon the resting stage of *Sclerotinia*, which it destroys entirely. (T. H.)

1070. Bos, J. Ritzema. **De klaverkanker, eene zich meer en meer uitbreidende klaverziekte.** <Wageningen, May 16, 1892, pp. 13.

Contains a general sketch of the canker, which affects *Trifolium pratense* especially, due to *Sclerotinia trifoliorum*. Besides a description of the life history of this fungus, the author gives some statements as to the eradication of the disease, and recommends digging out the infested parts of the clover field and burning the plants in a pit which has been partly filled with quicklime. The disease has been observed in several places in Holland, especially in Gröningen, Zeeland, and North Brabant. (T. H.)

1071. Cobb, N. A. **Notes on the diseases of plants.** <Agr. Gaz. N. S. Wales, vol. II, Sydney, Oct., 1891, pp. 616–624, pl. 2, figs. 5.

Gives notes on diseases of plants, as follows: Onion mildew, caused by *Peronospora schleideniana*, and for which Bordeaux mixture is recommended; tobacco mildew, caused by *Peronospora hyoscyami*; potato blight, murrain, or rot, caused by *Phytophthora infestans*, although not yet known in the colony, is fully described so that it may be known if it should appear. Bordeaux mixture is given as one preventive, clean culture and high molding being others; and banana disease, the cause of which is unknown, but may be due to a fungus attacking the roots. Mention is also made of the occurrence of bread mold on oranges, supposed to be caused by injury to the fruit. (For portion relating to diseased banana plants, see Bull. Bot. Dept. Jamaica, No. 31, May, 1892, p. 2; also, under title of "Banana disease in Fiji," Bull. Miscel. Infor. Royal Gard. Kew, No. 62, Feb., 1892, pp. 48–49.) (J. F. J.)

1072. Cobb, N. A. **Smut.** <Agr. Gaz. N. S. Wales, vol. II, Sydney, Nov., 1891, pp. 672–677, figs. 4.

Describes the various forms of smut of cereals; caused in oats by *Ustilago avenæ*: in wheat by *U. tritici*, *Urocystis occulta*, and *Tilletia fœtens*; also describes smut in maize. Gives various methods of treatment, mainly hot water and "bluestone." These last are recommended for all the smuts. (J. F. J.)

1073. C[ockrell], T. D. A. **The new coffee disease.** <Notes from Mus. Inst. Jamaica, No. 27 [Kingston], Oct. 29, 1892, p. 1.

Refers to disease of fungous origin affecting leaves of coffee. In appearance the disease resembles potato rot. The name of the fungus was not determined. (J. F. J.)

1074. C[ockrell], T. D. A. **The sugar-cane fungus.** <Notes from Mus. Inst. Jamaica, No. 18 [Kingston], July 23, 1892, p. 1.

States that specimens sent from Trinidad affecting sugar cane belong to a species to be described as *Trullula sacchari* Ell. & Ev. Says also that a bacterial disease may be present, but of this there is as yet no absolute proof. (J. F. J.)

1075. C[ooke], M. C. **Tobacco disease.** <Gard. Chron., 3d ser., vol. IX, London, Feb. 7, 1891, p. 173, ½ col.

Notes the occurrence of *Peronospora hyoscyami* in Australia, where it attacks tobacco leaves. Describes the appearance of the fungus, and suggests burning all diseased plants. Does not believe spraying with fungicides would be of any benefit in checking the disease. (J. F. J.)

076. Detmers, Freda. **[Fungus on Lactuca.]** <Ohio Agr. Exp. Sta. Bull. No. 44, Columbus, Sept., 1892, pp. 145–146, figs. 3.

Describes general appearance of *Septoria consimilis*, introduced from *Lactuca scariola* to cultivated lettuce. (J. F. J.)

077. Detmers, Freda. **Scab of wheat.** <Ohio Agr. Exp. Sta. Bull. No. 44, Columbus, Sept., 1892, pp. 147–149, figs. 2.

Describes appearance and mode of attack of *Fusisporium culmorum* W. Sm., causing wheat scab (see Am. Agr., vol. LI, Dec., 1892, p. 756). (J. F. J.)

078. Halsted, B. D. **Anthracnose in bean seeds.** <Gard. and Forest, vol. V, New York, Jan. 13, 1892, p. 18, ½ col.

States the disease is caused by *Colletotrichum lindemuthianum*. Describes general appearance of affected seed, and says that those showing disease did not germinate as well as healthy seed, and the plants were diseased. Advocates soaking seed in solution of 3 ounces of carbonate of copper, 1 quart of ammonia water, and 4½ gallons of water. (J. F. J.)

079. Halsted, B. D. **Some fungous diseases of the celery.** <N. J. Agr. Exp. Sta. Special Bull. Q, New Brunswick, Apr. 21, 1892, pp. 12, figs. 14.

Describes celery blight or "rust" as caused by *Cercospora apii*, giving an account of successful treatment with ammoniacal copper carbonate solution; celery leaf-spot due to *Phyllosticta apii* n. sp; another leaf-blight, due to *Septoria petroselini* var. *apii*; celery rust proper, due to *Puccinia bullata*; and a bacterial disease of celery that attacks and destroys the hearts of the plants. It is thought that ammoniacal copper carbonate solution can be successfully used for all three diseases (see also Am. Agr., July, 1892, vol. LI, pp. 426–427; Exp. Sta. Rec., vol. III, July, 1892, pp. 884–885). (J. F. J.)

1080. Humphrey, J. E. **The powdery mildew of the cucumber (Erysiphe cichoracearum DC.)** <Ninth Ann. Rept. Mass. Agr. Exp. Sta. for 1891, Amherst, 1892, pp. 222–226.

Describes the appearance and development of the disease. Recommends as a preventive a solution of sulphide of potassium (liver of sulphur), 1 ounce to 4 gallons of water. Stronger solutions injure the leaves. Ammoniacal carbonate of copper solution also effective, and vapor of sulphur better than either, care being taken not to have the sulphur burn (see No. 394). (J. F. J.)

1081. Humphrey, J. E. **The rotting of lettuce (Botrytis vulgaris, Fr.).** <Ninth Ann. Rept. Mass. Agr. Exp. Sta. for 1891, Amherst, 1892, pp. 219–222.

Describes the disease as due to *Botrytis*, possibly *B. vulgaris*, and traces its development. Considers *B. vulgaris* to be the conidial stage of some Sclerotium-producing Peziza. Recommends clean culture and keeping plants in a healthy condition as best preventives (see No. 394). (J. F. J.)

1082. Humphrey, J. E. **Various diseases [of potato, etc.].** <Ninth Ann. Rept. Mass. Agr. Exp. Sta. for 1891, Amherst, 1892, pp. 226–235.

Preliminary notes on diseases of the following plants: Potato, caused by a species of *Macrosporium*; cucumber, caused by *Acremonium (?)* sp.; rye, caused by *Urocystis occulta* Wallr., and also by *Puccinia rubigo-vera* (DC.) Wint.; cabbage, caused by *Plasmodiophora brassicæ* Wor.; celery, caused by a species of *Cercospora* or *Septoria*, probably that described by Chester as *S. petroselini* var. *apii*, occurring in Delaware; clover, caused by *Uromyces trifolii* and *Polythrincium trifolii* Kze.; fish eggs, caused by *Achlya racemosa* Hild.; black poplar, caused by *Melampsora populina* (Jacq.) Lev.; chestnut, caused by *Marsonia ochroleuca* (B. & C.); also plum and tobacco diseases. (J. F. J.)

1083. Jones, L. R. **Plant diseases.** <Vt. Agr. Exp. Sta. Bull. No. 28, Burlington, Apr., 1892, pp. 15–36, fig. 1.

The following diseases are discussed: (1) Potato blight and rot; this was successfully treated by the use of Bordeaux mixture; the question whether it will pay to spray is answered in the affirmative; the expense of spraying and method of making and applying the mixture are given. (2) A new potato disease, differing in various respects from ordinary blight, and thought to be possibly due to bacteria. (3) Potato scab, which is described mainly from the North Dakota Agr. Exp. Sta. Bull. No. 4 (see No. 58). (4) Apple and pear scab, both of which were successfully treated, ammoniacal copper carbonate solution being preferred to Bordeaux mixture, as it does not injure the foliage and is cheaper; directions are given for making and applying the fungicides. (5) Oat smut, which can be prevented by the Jensen hot-water treatment, and for which directions are given (see Exp. Sta. Rec., vol. III, July, 1892, pp. 891–892). (J. F. J.)

1084. Kerr, Chas. **Diseases of eggplants.** <Fla. Disp. Farm and Fruit Grower, n. ser., vol. IV, Jacksonville, Apr. 21, 1892, p. 307, ½ col.

Notes the "falling" of eggplants as due to *Pythium debaryanum*. Considers the "falling" the same as "damping off," and gives only remedy known to him as plenty of light and air and not too much moisture. (J. F. J.)

1085. McAlpine, D. **Vegetable pathology.** <Dept. of Agr. Victoria, Bull. No 14, Melbourne, Dec., 1891, pp. 21–50, pl. 3.

Gives more or less complete accounts of the following diseases: (1) Rust of wheat, describing its cause and life history, and giving a list of host plants: it is due to *Puccinia graminis*. (2) Wheat blight, due to *Septoria tritici*. (3) Club-root of cauliflowers, cabbage, etc., due to *Plasmodiophora brassicæ*, mentioning the conditions favoring the disease and giving a sketch of the life history of the fungus. (4) Beet leaf rust, caused by *Uromyces betæ*. (5) Raspberry root fungus, the cause of which is stated to be *Rhizomorpha*. (6) Root gall disease of cucumbers, due to a nematode worm. The descriptions of the diseases are accompanied by notes on remedies. (J. F. J.)

1086. Lamson-Scribner, F. **The fungous diseases of plants.** <Proc. 16th Ann. Meeting East Tennessee Farmers' Convention, May 19 and 20, 1891, Nashville, 1891, pp. 16–25.

An address concerning various fungous diseases, and treating of smuts of corn, oats and wheat; mildew of potato; potato rot and scab; rusts of wheat, corn, apple, and blackberry; and pear blight. Gives remedies for most of these, and discusses liquid and powder fungicides, with means of applying remedies, and mention of good results ensuing. Issued as a separate under title of "Address on the fungous diseases of plants," Nashville, 1891, pp. 31. (J. F. J.)

1087. Speer, R. P. **Our rusted and blighted wheat, oats, and barley in 1890.** <Iowa Agr. Exp. Sta. Bull. No. 10 [Ames], Aug., 1890, pp. 391–400.

Refers to the fact that many kinds of oats, wheat, and barley are invariably injured by rust, and gives details of experiments. Mentions varieties planted, and notes that all varieties except Mansbury barley were badly rusted, most of them so badly as not to be worth harvesting. Discusses the change in climate due to the cultivation of the prairies of the State and shows the relation between climate and attacks of rust. States that crops are never injured by rust where there are no great extremes of summer temperature and no severe spells of drought. Advocates sowing of clover to regenerate the land, and gives

1087. SPEER, R. P.—Continued.

as the result of observation and experiment the following: (1) If oats continue to be grown they should be sown as early in the spring as possible, and only such varieties as the Everett or improved American should be used: (2) of barleys the most valuable is the Mansbury, which should be sown early and raised in preference to oats of any variety; (3) all varieties of spring wheat are unreliable and should be discarded. The best varieties of winter wheat tested were Turkish and Golden Cross (see also Exp. Sta. Rec., vol. II, Dec., 1890, pp. 213-215). (J. F. J.)

1088. STURGIS, W. C. **Preliminary report on the so-called "pole-burn" of tobacco.** <Ann. Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 168-184.

Discusses the origin of the disease, due to a fungus, and caused by hanging the tobacco so close as to prevent free circulation of air, and by the presence of moisture, due to fogs, dew, etc. Describes the effects of the disease, and states it is due to a species of *Cladosporium*, which, by partially destroying the tissues of the leaf, gives access to bacteria. Describes methods of culture and gives remedies; the latter are, better ventilation and improved methods of curing, mainly by artificial heat (see Exp. Sta. Rec., vol. III, June, 1892, pp 773-775). (J. F. J.)

089. STURGIS, W. C. **Stem-rot [of tobacco].** <Ann. Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 184-186.

Describes appearance of disease and states that it is due to a fungus referred provisionally to the genus *Botrytis*. Gives brief sketch of life history and names it *B. longibrachiata*. As remedies, recommends cleanliness, burning all diseased stems and leaves, and having the barn floor sprinkled with air-slaked lime and sulphur. If floor be of earth, cover with clean, dry earth to depth of 1 inch. Fumigation by burning sulphur also recommended (see Exp. Sta. Rec., vol. III, June, 1892, pp. 775-777). (J. F. J.)

090. THAXTER, R. **Potato scab.** <Ann Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 153-160.

Reviews work of Bolley, Arthur, and himself on the disease, and quotes from Bolley as to the identity of surface and deep scab (see No. 382). Gives details of experiments in planting scabby tubers, and concludes that application of fungicides to plants is useless. Recommends (1) use of seed free from scab; (2) not to plant on land which has produced diseased crops of potatoes or beets or has been fertilized with manure from stock fed with scabby potatoes; (3) not to feed scabby tubers to stock without cooking; (4) fertilize with other materials than barnyard manure; (5) dig potatoes as soon as possible after maturity. Describes fungus producing the disease under name of *Oöspora scabies*, n. sp., and discusses its position in classification (see Nos. 238 and 311; also Exp. Sta. Rec., vol. III, June, 1892, pp. 771-772). (J. F. J.)

091. TRACY, S. M. **Cooperative branch stations in the South.** <Rept. Sec. of Agr. for 1891, Washington, 1892, pp. 5-12 (reprint).

On p. 8 notes that *Puccinia coronata* attacks and kills *Holcus lanatus* when about ready to bloom. (J. F. J.)

092. WINDMILLER, FR. **How to prevent tomato rot.** <Am. Gardening, vol. XIII, New York, Apr., 1892, p. 221, ⅔ col.

Gives experience in planting tomatoes for two years in succession on same ground, and concludes it is necessary to plant crop on new ground each year if rot is to be prevented. (J. F. J.)

(See also Nos. 1053, 1105, 1107, 1108, 1172, 1192, 1196, 1204.)

III.—DISEASES OF FRUITS.

093. [ANON.] **Apple scab (Fusicladium dendriticum).** <Grev., vol. XX, No. 93, Sept., 1891, London, pp. 27-29.

Notes the receipt of strongly developed specimens of this fungus on leaves of the apple from different parts of the country [Great Britain] and a profusion of samples from Australia. The recommendations for treatment by spraying with fungicides are quoted from the U. S. Department of Agriculture Reports (see Gard. Chron., 3d ser., vol. X, Nov. 14, 1891, p. 580). (M. B. W.)

094. [ANON.] **Bladder plums.** <Gard. Chron., 3d ser., vol. IX, London, May 30, 1891, pp. 672-673, figs. 2.

Notes the disease to be due to *Taphrina* or *Exoascus pruni* and states a close connection exists between it and *Exoascus deformans* causing peach blister. (J. F. J.)

095. [ANON.] **Citron culture in Corsica.** <Gard. Chron., 3d ser., vol. XI, London, Jan. 30 and Feb. 6, 1892, pp. 149-150, 182-183.

In noticing a report of the British Consul at Ajaccio, refers to diseases affecting the tree. "White-root" is the worst Due to a fungus attacking the cortical tissue of the root. Describes appearance. Recommends, (1) pruning to the quick all roots deprived of vitality and apportioning branches to correspond to root system, and then surrounding tree with deep trench with a free passage for overflow of water; (2) pruning affected roots and applying

1095. [ANON.]—Continued.

tar to cut ends (this gives best results); (3) aeration of roots, exposing them and filling in ... with stones or charcoal and filling up about trunk of tree 15 inches above surface of ground. *Fumagine* (smut or citron black) also described. Destroyed by whitewashing tree as far as bark extends and spraying the leaves. Tobacco juice and soft-soap spray also gives good results. The branches should also be trimmed out so as to allow air to circulate freely. (J. F. J.)

1096. [ANON.] **Raspberry anthracnose.** <Am. Gardening, vol. XIII, New York, Apr., 1892, p. 239, ½ col.

Describes the disease and recommends plenty of air and sunlight between the canes. Before buds start, spray with sulphate of iron (2 pounds in 5 gallons of water), and if it appears later use Bordeaux mixture. Burn badly diseased canes. (J. F. J.)

1097. [ANON.] **The filbert fungus.** <Am. Agr., vol. LI, New York, Dec., 1892, p. 7..., ⅓ col.

States that as the fungus affecting filberts has not yet been discovered, there is no method to be recommended to check it. It resembles black knot of plum and cherry, but ... belongs to a different genus. It is destructive to foreign varieties, but does not seem ... to have attacked natives. (J. F. J.)

1098. ATKINS, JR., E. [**Peach-rust and fire-blight.**] <Dept. Agr. N. S. Wales, Bull. No. 4, Sydney, Feb., 1891, p. 24.

Notes the occurrence of the diseases at Ermington, and says lime will prevent the ... (J. F. J.)

1099. BAILEY, L. H. [**Fruit spot of plum.**] <Cornell Univ. Agr. Exp. Sta. Bull. No. ..., Ithaca, N. Y., June, 1892, p. 56, fig. 1.

Notes disease affecting the fruit, referred by Humphrey to a species of *Phoma*. (J. F. J.)

1100. "BEDFORD FARMER." **Fungous disease in orange trees.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Nov. 19, 1891, p. 118, ⅔ col.

Describes a disease affecting the bark of orange twigs. Ashes and sulphur applied ... stem of tree said to stop the disease. Supposed to be spread from tree to tree by water ... in irrigating. (J. F. J.)

1101. BEINLING, E. **Ueber das Auftreten von Rebenkrankheiten im Grossherzogtum Baden im Jahre 1891.** <Zeitsch. Pflanzenkrank., vol. II, Stuttgart, 18.. pp. 207–210.

The vine diseases in Baden in 1891 were especially mildew, black rot, and the so-called false mildew, due to *Peronospora viticola*. *Sphaceloma ampelinum*, the well-known anthracnose, has not been observed. Root mold, due to *Dematophora necatrix*, is, on the other hand, widespread and seems to increase every year. (T. H.)

1102. BESSEY, C. E. **The smut of Indian corn.** <Ohio Agr. Exp. Sta. Bull. No. ..., vol. III, 2d ser., Columbus, Nov., 1890, pp. 264–272, figs. 2.

Describes the general appearance of the disease and its wide prevalence. Opinions differ as to its effect on cattle, as shown by letters quoted. Describes the structure and growth of the spores, and discusses the question of how to reduce the quantity of smut. Clean cultivation, rotation of crops, destruction of infected plants, and use of clean seed, all said to have influence in reducing the amount. (J. F. J.)

1103. BRIDLE. [**Windsor pear-blight.**] <Dept. Agr. N. S. Wales, Bull. No. 4, Sydney Feb., 1891, p. 25.

States that disease is overcome to a certain extent by grafting the Windsor on ... stock. (J. F. J.)

1104. BRUNK, T. L. **Pear stocks.** <Tex. Agr. Exp. Sta. Bull. No. 9, College Station, May, 1890, pp. 5–22, figs. 7.

Refers to susceptibility of certain varieties of pears to blight, stating that Le Conte and Kieffer are less subject to the disease on well-drained soils in the Gulf States on their own roots than on French stock. Root rot of pears seems to be caused by *Ozonium* ..., which also affects cotton and other plants. Describes the effects of the disease in ... (J. F. J.)

1105. CHESTER, F. D. **Report of the mycologist.** <Third Ann. Rept. Del. Agr. Exp. Sta. for 1890, Newark, 1891, pp. 45–91, figs. 15.

Gives details of experiments in various vineyards to prevent black rot and anthracnose. Tables of the product of the vines and statements of the money value of the sprayings given. In a general way the experiments point to Bordeaux mixture as the best fungicide with which to treat badly infected vineyards, but when the disease has been brought under control after one or two seasons' work, carbonate of copper and carbonate of ammonia ... equally as effective and less expensive. Bordeaux mixture, while acting as a fungicide, possesses the additional advantage of stimulating the growth of the vines. It also ... anthracnose. An experiment in bagging grapes is also described, several periods of ... being mentioned. These seem dependent upon weather conditions. Directions are given ...

1105. CHESTER, F. D.—Continued.

preparing and applying the various fungicides used, and the spraying apparatus necessary is described. In experiments upon pear and quince leaf-blight, it was found that modified eau céleste, and carbonate of copper and carbonate of ammonia mixture gave the best results and were the two cheapest fungicides employed. An experiment with potato rot (*Phytophthora infestans*) is described, and Bordeaux mixture is noted as effectually controlling the disease. Bitter rot of the apple was experimented with, and sulphide of potassium gave fairly good results when used in the proportion of one-half ounce per gallon of water. Gives the results of a study of leaf spot of alfalfa produced by *Pseudopeziza medicaginis*, describing characters and life history as shown by artificial cultures. Rot of scarlet clover caused by *Sclerotinia trifolium* also described and its life history discussed. Scab of wheat caused by *Fusarum culmorum* described. Black rot of sweet potato (*Ceratocystis fimbriata*) was experimented with, and it was found that diseased soil will produce the disease even in healthy roots, that the soil can be rendered free of germs by sterilization or heat, and that plants grown from diseased tubers will probably become diseased. (J. F. J.)

1106. COBB [N. A.]. [**Fungous diseases of fruit trees**]. <Dept. Agr. N. S. Wales, Bull. No. 4, Sydney, Feb., 1891, pp. 19-22.

A general statement as to damage caused by fungi and their mode of growth and dissemination. Particular mention made of Windsor pear blight, thought to be caused by same fungus, as that causing apple scab, and for which ammoniacal copper carbonate is recommended; shot-hole fungus; bitter rot of apple, for which carbonate of copper and sulphide of potassium is recommended; strawberry leaf-blight, to be treated with Bordeaux mixture or 1 pound hyposulphite of soda in 10 gallons of water before disease appears; anthracnose of the vine, leaf spot, fire blight, peach rust, plum rust, and fig blight were incidentally mentioned. Peach rust sometimes goes by the name of yellows. (J. F. J.)

1107. COBB, N. A. **Plant diseases and how to prevent them.** <Agr. Gaz. N. S. Wales, vol. III, Sydney, Apr., 1892, pp. 276-303, pl. 4, figs. 26.

Treats of the diseases mentioned below, giving sketch of life history of the fungus and recommendations of preventives. (1) Of the apple: (*a*) Apple scab or "Tasmanian black spot," caused by *Fusicladium dendriticum*, for which is recommended ammoniacal carbonate of copper, modified eau céleste, or Bordeaux mixture; (*b*) powdery mildew, caused by *Podosphæra kunzei* Lév., for which ammoniacal carbonate of copper or modified eau céleste are recommended; (*c*) bitter or ripe rot, caused by *Glœosporium versi-color* B. & C., and treated with ammoniacal cop er carbonate; (*d*) moldy core, treated by modified eau céleste or ammoniacal copper carbonate; (*e*) water core; (*f*) an obscure disease causing the fruit to become distorted and misshapen. (2) Diseases of pears: (*a*) Pear scab or Windsor pear-blight, caused by *Fusicladium pyrinum* and treated by same fungicides as apple scab; (*b*) leaf-blight (*Entomosporium maculatum*), which has not appeared in Australia (3) Shot-hole disease of apricot and other stone fruits, caused by *Phyllosticta circumscissa* and treated with Bordeaux mixture, ammoniacal copper carbonate, or eau céleste. (4) Diseases of the vine: (*a*) Anthracnose or "black spot," caused by *Glœosporium ampelinum* Sacc., and treated by cutting off and burning affected parts, using lime and sulphur and applying Bordeaux mixture or eau céleste; (*b*) tufted leaf-blight, caused by *Cercospora viticola*, for which Bordeaux mixture is recommended. (5) Strawberry leaf-blight, caused by *Sphærella fragariæ*, for which burning the diseased leaves and spraying with Bordeaux mixture or ammonia carbonate of copper is recommended. (6) Pumpkin-leaf Oidium, caused by *O. erysiphoides*, treated with flowers of sulphur or Bordeaux mixture. (7) Powdery mildew of rose, caused by *Sphærotheca pannosa* and treated with flowers of sulphur or Bordeaux mixture. The formula for carbonate of copper and descriptions of spraying apparatus are also given. (J. F. J.)

1108. COBB, N. A. **Plant diseases and how to prevent them.** <Agr. Gaz. N. S. Wales, vol. III, Sydney, June, 1892, pp. 436-439, figs. 3.

Describes, (1) "Pourridie or moldy root of the vine," caused by *Agaricus melleus*; recommends as a remedy thorough drainage. (2) Tufted leaf-blight of the bean, caused by a fungus which is not named; recommends rotation of crops and advises trial of Bordeaux mixture. (3) Apple canker, caused by some mechanical injury to the bark which is seized upon by some fungus and the healing thereby prevented. Pruning and the use of whitewash are recommended as remedies. (J. F. J.)

1109. CRAIG, JOHN. **A destructive disease affecting native plums.** <Ottawa Nat., vol. VI, Ottawa, Nov., 1892, pp. 109-112, fig. 1.

Refers to disease caused by *Cladosporium carpophilum* and quotes description given by Pammel, of Iowa. Describes the characters and notes the varieties affected. Recommends use of weak solution of copper sulphate, 1 ounce to 25 gallons of water. (J. F. J.)

1110. CRAIG, J. **Fusicladium on cherry.** <Ottawa Nat., vol. VI, Ottawa, Nov., 1892, p. 115.

Refers to the presence of *Fusicladium dendriticum* on the fruit and foliage of cherry causing great loss where occurring. (J. F. J.)

1111. DIVISION OF VEGETABLE PATHOLOGY. **Pear blossom-blight.** <Fla. Disp. Farm, and Fruit Grower, n. ser., vol. IV, Jacksonville, Apr. 21, 1892, p. 304, ½ col.

A letter written from the U. S. Department of Agriculture to L. B. Wombwell, State commissioner of agriculture, describing the method of spread of the disease by insects. Its spread through the orchard may possibly be prevented by spraying at the time of blooming. (J. F. J.)

1112. DOBSON, W. R. **Diseases of plants [peach rot].** <St. Louis Republic, St. Louis, May 15, 1892, ½ col.

Refers to the great destruction caused by rot (Monilia), and considers best remedy b... ing diseased peaches and branches. A dilute solution of copper and ammonium car... said to prevent the rot, but to injure the leaves (see also Colman's Rural World, vol. ... May 26, 1892, p. 163, ⅜ col.). (J. F. J.)

1113. GARMAN, H. **Bordeaux mixture for apple pests.** <Ky. Agr. Exp. Sta. Bull. No. 44, Lexington, Jan., 1893, pp. 32, figs. 3.

Describes the appearance of apple rot caused by *Glœosporium versicolor*. Discusses the source of the rot and gives the microscopical characters of the fungus. This is followed ... details of a number of experiments. The results of these show that Bordeaux mixture causes an increase in size of leaves, in numbers and size of fruits, prevention of sca... leaf spot, and a lessening of injury from rot. Apple scab can be treated with the same fungicide as rot. (J. F. J.)

1114. KELLERMAN, W. A. **Vegetable pathology, May.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, July, 1892, pp. 70–71.

Notes that peach curl has been abundant and describes its general characters. Refers ... to black knot and bramble rust, advocating the destruction of weeds to prevent vario... species of fungi from infesting cultivated crops. (J. F. J.)

1115. [KIMBER, W.] **Visit to Angaston.** <Gard. and Field, vol. XVII, Adelaide, Feb. 17, 1892, p. 186, 1½ col.

Gives an account of apple orchard badly affected by *Fusicladium dendriticum*. (J. F. J.)

1116. MACOWAN, P. **Leaf-blight and powdery mildew in fruit trees.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, July 16, 1891, pp. 1–3, figs. 2.

Gives figures of amount of fruit sent out from California and refers to the work ... to combat fungous pests in America. Quotes Circular No. 10 (treatment of nursery sto... leaf-blight and powdery mildew) of the Division of Vegetable Pathology. (J. F. J.)

1117. MCALPINE, D. **Report on peach and plum leaf-rust (Puccinia pruni).** <Dep. of Agr. Victoria, Bull. No. 14, Melbourne, Dec., 1891, pp. 138–148.

Describes the disease and gives the life history of the fungus causing it. Notes ... varieties of fruit affected the distribution of the disease, and suggests various rem... among them the use of Bordeaux mixture and sulphate of iron dissolved in water ... rate of 1 pound to 8 gallons. (J. F. J.)

1118. [MEEHAN, THOS.] **Black knot in the plum.** <Meehan's Monthly, vol. II, Germantown, Pa., June, 1892, p. 93, ½ col.

Mentions various hosts of *Plowrightia morbosa*, and states that it is probably th... fungus which produces knots on the roots of young peach trees near the collar. (J. F. ...

1119. MILLS, ——. **[Fire blight.]** <Dept. of Agr. N. S. Wales, Bull. No. 4, Sydney, Feb., 1891, p. 24.

Notes the occurrence of fire blight at Dundas and remarks upon its rapid spread. (J. F. J.)

1120. PULVER, ——. **[Peach rust.]** <Dept. Agr. N. S. Wales, Bull. No. 4, Sydney, Feb., 1891, p. 24.

Notes occurrence of disease at Wagga Wagga, where it is called "yellows." (J. F. J.)

1121. [ROBIN, A. B.] **Diseased cherry trees.** <Gard. and Field, vol. XVII, Adelaide, Feb., 1892, pp. 182–183, 1$\frac{1}{10}$ col.

Records a disease of cherry trees in Nuriootpa [identified by N. A. Cobb as due to M. *fructigena*]. On p. 183 a solution of sulphate of iron is recommended by Cobb as a ... (J. F. J.)

1122. SCOBIE, ——. **[Discussion of fruit-tree diseases.]** <Dept. Agr. N. S. Wales, Bull. No. 4, Sydney, Feb., 1891, pp. 23–24.

Mentions various diseases observed, such as apple scab, bitter rot, strawberry lea... disease of the vine, fire blight, and peach and plum rust. (J. F. J.)

1123. [VARIOUS.] **Pear blight.** <Ann. Rept. State Board Hort. of Cal. for ..., Sacramento, 1892, pp. 414–415.

A discussion upon the subject, some considering the disease occurring on Californ... to be true pear blight (*Bacillus amylovorus*) and others as something different. (J. F. J.)

(See also Nos. 1057, 1061, 1083, 1085, 1086, 1112, 1142, 1157, 1158, 1172, ... 1204, 1210, 1215.)

IV.—DISEASES OF FOREST AND SHADE TREES.

1124. [ANON.] **[Forest tree fungi.]** <Gard. and Forest, vol. III, New York, July 16, 1890, p. 352, 8 lines.

Notes *Glœosporium aridum* on ash and *Microstoma juglandis* on leaves of hickory as being abundant. (J. F. J.)

1125. [ANON.] **Pine blister.** <Gard. Chron., 3d ser., vol. IX, London, May 9, 1891, pp. 598, 599, fig. 1.

States that the disease is caused by *Peridermium pini*, and believes some connection exists between it and *Coleosporium senecionis*. Recommends removal of Groundsel (*Senecio jacobœa*) from vicinity of trees. (J. F. J.)

1126. BRUNCHORST, I. **Nogle sygdomme i de vestlandske træplantninger.** <Naturen, vol. XV, Bergen, Sept., 1891, pp. 257-269, pl. 1.

Pinus sylvestris and *Larix europæa* are often injured in Norway by fungi. The author gives a popular account of some of these diseases, accompanied by some figures giving the Norwegian names for the diseases, but omitting the scientific names of the fungi. (T. H.)

1127. [EDITORIAL.] **[Sycamore blight.]** <Gard. and Forest, vol. III, New York, June 18, 1890, p. 304, $\frac{1}{6}$ col.

Notes the occurrence of *Glœosporium nervisequum* on Sycamore trees in Central Park, N. Y. Asks for reports of occurrence in other places. (J. F. J.)

1128. J. ——. **Fungoid growth on trees.** <The Garden, vol. XXXIX, London, Jan. 24, 1891, p. 88, $\frac{1}{2}$ col.

Notes the occurrence of decay in trees and ascribes a particular case to the growth of fungous mycelium in a post near by. This fungus eventually attacked the roots of the tree. Another tree was found to have been infected by mycelia from a plank lying in contact with the roots. (J. F. J.)

1129. M. ——. **Destruction of tree roots by fungi.** <Agr. Jour. Cape Colony, vol. III, Cape Town, Mar. 19, Apr. 9, 1891, pp. 169-170, 182-183.

Notes that the common root destroyers of South Africa are *Agaricus melleus* and *Polyporus sulphureus*. Gives a sketch of the life history of each. For the first he recommends the removal of the earth about the collar of the tree and then the application of sulphate of iron or sulphate of copper, filling in again with fresh loam For Polyporus there is no cure. The latter gains an entrance into the tree trunk through wounds in the bark (see Gard. Chron., 3d ser., vol. IX, June 13, 1891, p. 734, 2 col) (J. F. J.)

130. [MEEHAN, THOS.] **Diseases in Rhododendrons.** <Meehan's Monthy, vol. II, Germantown, Pa., June, 1892, p. 89, 1 col.

Describes the work of a fungus similar to that attacking pear trees. Also notes work of mycelium of a species of *Agaricus* attacking the roots. Flowers of sulphur destroyed the Agaric and the leaves recovered their normal green color. Suggests that copper solution might destroy the fungus working on the branches. (J. F. J.)

131. OLLIFF, A. SYDNEY. **Diseased pepper tree.** <Agr. Gaz. N. S. Wales, vol. II, Sydney, Nov., 1891, p. 670.

States that the disease is due to a fungus arising from the presence of honeydew caused by a species of scale insect. Recommends kerosene emulsion as a remedy for the scale and thus a preventive of the fungous growth. (J. F. J.)

(See also Nos. 1046, 1062, 1082.)

V.—DISEASES OF ORNAMENTAL PLANTS.

.32. [ANON.] **[New primula disease.]** <Am. Florist, vol. VII, Chicago and New York, Dec. 31, 1891, p. 454, $\frac{1}{10}$ col.

Notes a mildew of primula new to Great Britain, due to *Ramularia primulæ* Thüm. (J. F. J.)

133. [ANON.] **Pancratiums diseased.** <Gard. Chron., 3d ser., vol. IX, London, Feb. 7, 1891, p. 182, $\frac{1}{3}$ col.

The disease is caused by *Saccharomyces glutinis*. Recommends removal and burning of soil where bulbs are growing, and destruction of all diseased portions of plants. Soak bulbs in solution of potassium sulphide and use every means to have healthy plants. (J. F. J.)

34. [ANON.] **The carnation rust.** <Gard. and Forest, vol. V, New York, Jan. 13, 1892, pp. 18, 19, figs. 2, $1\frac{1}{2}$ col.

Notes the extent of the disease in this country caused by *Uromyces caryophyllinus*. Thinks cuttings dipped in Bordeaux mixture will be free from disease. (J. F. J.)

1135. ARTHUR, J. C. **Fungus on carnations.** <Am. Florist, vol. VII, Chicago and New York, Jan. 7, 1892, p. 462, ½ col.

States disease to be a rust known long ago in Europe and only recently brought to this country. The fungus may be recognized by brown spots on the leaves and stems, ¼ to ½ of an inch long, filled with a dark, loose powder, which readily comes off on the fingers. Suggests use of only healthy cuttings, clean cultivation, and fumigation of greenhouse with sulphur before planting in benches. (J. F. J.)

1136. HALSTED, B. D. **A chrysanthemum blight.** <Gard. and Forest, vol. IV, New York, Nov. 25, 1891, p. 560, ½ col.

Notes peculiar blotching of leaves due to species of *Septoria*. Gives brief sketch of growth. Spraying with copper compounds recommended. (J. F. J.)

1137. HALSTED, B. D. **Alternanthera leaf-blight.** <Gard. and Forest, vol. V, New York, Feb. 3, 1892, pp. 56–57, ½ col.

Describes appearance of plants affected by a fungus closely related to *Phyllosticta amaranthi*. Thinks either Bordeaux mixture or ammoniacal copper carbonate solution would be an effectual preventive. (J. F. J.)

1138. HALSTED, B. D. **Petunia blight.** <Gard. and Forest, vol. V, New York, Mar. 23, 1892, p. 141, ½ col.

Disease due to *Ascochyta petuniæ*. Describes appearance. *Septoria*, perhaps new, and for which *S. petuniæ* is provisionally proposed, was also found on leaves. Diseases can be held in check by use of fungicides. (J. F. J.)

1139. KELLERMAN, W. A. **Some fungous pests of greenhouse plants.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, Mar., 1892, pp. 20–23.

Gives descriptions of rust of carnations, caused by *Uromyces caryophyllinus*, and damping off, caused by species of *Pythium*. The best preventives seem to be good ventilation, not too high temperature, and good cultivation. In the discussion Mr. Warner stated that sulphur could be used to advantage in arresting the damping-off fungus. (J. F. J.)

1140. THAXTER, R. **Fungus in violet roots.** <Ann. Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 166–167.

Notes the diseased condition of violets, which may or may not be connected with *Phyllosticta violæ* attacking the leaves. Finds a fungus on the roots identified as *Thielavia basicola*, which is the same as *Helminthosporium fragile* and *Torula basicola*. Considers it doubtful if the fungus is wholly responsible for the diseased condition of the violet roots (see Exp. Sta. Rec., vol. III, June, 1892, p. 773). (J. F. J.)

(See also Nos. 1039, 1044, 1063, 1107, 1175, 1220, 1222.)

D.—REMEDIES, PREVENTIVES, APPLIANCES, ETC.

1141. ALWOOD, W. B. **Treatment of diseases of the grape.** <Va. Agr. Exp. Sta. Bull. No. 15, Blacksburg, Apr., 1892, pp. 31–43.

Notes the amount of damage caused by fungi on grapes, and treats the following topics: Preparations used as fungicides, formulæ for fungicides, methods of preparation, cost, manner of treatment of vineyards, results of tests made with fungicides, and "Is sprayed fruit unwholesome?" Recommends use of fungicides, especially weak Bordeaux mixture, and concludes that there is no danger from the use of sprayed grapes. (J. F. J.)

1142. ANDERSON [H. C. L.] **[Fruit-tree diseases.]** <Dept. Agr. N. S. Wales Bull. No. 4, Sydney, Feb., 1891, pp. 25–26.

Refers to peach rust and success in treating trees with sulphate of iron. Wood ashes used as fertilizer. Large doses of kainit enabled the trees to throw off the disease better than those dressed with wood ashes or lime. Recommends spraying trees in winter with 1 pound of sulphate of iron in 8 gallons of water and applying potash in addition. (J. F. J.)

1143. [ANON.] **A new fungicide.** <Am. Florist, vol. VII, Chicago and New York, Mar. 3, 1892, p. 640, $\frac{1}{10}$ col.

Mentions a dry powder made by C. H. Joosten, New York, that when applied is like a cloud of smoke and so reaches every part of the plant. (J. F. J.)

1144. [ANON.] **Copper salts for the prevention and palliation of the potato disease.** <Gard. Chron., 3d ser., vol. XI, London, Mar. 26, 1892, p. 403, ½ col.

Notices the work of Messrs. Robt. Veitch & Son for the prevention of the disease, giving negative results with the copper, but successful results in earthing up. Notes also that a consular report records the successful use of copper sulphate and lime for potato disease in France. (J. F. J.)

1145. [ANON.] **Copper solution [for tomatoes].** <Gard. Chron., 3d ser., vol. XI, London, Apr. 16, 1892, pp. 505–506, ⅙ col.

Gives directions for making spraying solution with 4½ pounds of sulphate of copper dissolved in 3½ gallons of water and 3½ pounds of carbonate of soda and ½ pound of molasses; stir, allow to stand twelve hours, and then dilute with 22 gallons of water. Spray two or three times during season, stopping when fruit begins to color. This is the remedy for mildew. (J. F. J.)

1146. [ANON.] **History of the Bordeaux mixture.** <Rural New Yorker, vol. L, New York, Oct. 17, 1891, p. 741, 1 col.

Gives an account of the first use of Bordeaux mixture as a fungicide, and mentions many experiments since made with it. Notes that it is often improperly applied, and that it should not be used as a spray after the grapes begin to color. (J. F. J.)

1147. [ANON.] **Mildew on strawberries.** <Gard. Chron., 3d ser., vol. XI, London, Jan., 1892, p. 58, ½ col.

Considers mildew due to method of cultivation. Recommends having beds slope toward south and plenty of air circulating. In house culture keep air stirring and strew sulphur about. Out of doors dressings of Bordeaux mixture would be beneficial. (J. F. J.)

1148. [ANON.] **[Plum rot.]** <Am. Agr., vol. L, New York, Feb., 1891, p. 96, ⅛ col.

Recommends ammoniacal copper carbonate solution as a remedy, spraying first when plums are size of peas, and thereafter every six or seven days until the fruit is two-thirds grown. (J. F. J.)

1149. [ANON.] **Potato culture.** <Ann. Rept. Sec. for Agr., Nova Scotia, for 1890, Halifax, 1891, pp. 60–65.

On p. 62 notes that nitrogenous fertilizers increase percentage of diseased tubers; with mineral fertilizers the percentage was much less. (J. F. J.)

1150. [ANON.] **Potato disease.** <Nat. Provisioner, vol. IV, New York, Mar. 19, 1892.

Mentions experiments made in France to prevent potato disease with sulphate of copper, lime, and water called "bouillie Bordelaise." States that the addition of molasses enables the mixture to stick to the leaves and is not washed off by rain. (J. F. J.)

1151. [ANON.] **Potato disease and the copper treatment.** <Gard. Chron., 3d ser., vol. XI, Feb. 6, 1892, London, p. 178, ½ col.

From the *Morning Post* it is learned that the Highland and Agricultural Society has been conducting experiments on potatoes. The spray of Bordeaux mixture has entirely failed to restrain the fungus of the potato blight. (M. B. W.)

1152. [ANON.] **Renseignements sur la maladie des pommes de terre et sur les traitements effectués en 1891.** <Chron. Agr. du Canton de Vaud, vol. V, Lausanne, Mar. 10, 1892, pp. 94–99.

A notice of the results of experiments made by various persons at different places to prevent potato rot. The principal substance used was Bordeaux mixture and the treatment was generally successful. (J. F. J.)

1153. [ANON.] **Revue Horticole.** <Nouv. Ann. Soc. d'Hort. Gironde, June, 1891, Bordeaux, pp. 108–109.

A note on the successful treatment of chlorosis with sulphate of iron. States that chlorosis had been thought to be due to lack of light, improper nutrition, etc., but the chlorosis spoken of was due to lack of iron. The remedy consisted in scattering around each diseased tree in February 250 grams of dry sulphate of iron. (M. B. W.)

1154. [ANON.] **Rust in wheat.** <Gard. Chron., 3d ser., vol. X, London, Oct. 31, 1891, p. 521, ½ col.

Quotes from Mark Lane Express in relation to prize of £10,000 offered in Australia for successful preventive of wheat rust. A solution of copper sulphate (1 part to 400 of water) destroys the vitality of the spores, and spraying with 1 ounce of sulphate of iron in a gallon of water retarded appearance of rust, destroyed the rust when it appeared, and prevented its appearance for fourteen days afterward. (J. F. J.)

1155. [ANON.] **Rust in wheat.** <Agr. Gaz. N. S. Wales, vol. III, Sidney, March, 1892, pp. 221–226.

Gives the substance of the recommendations of the wheat conference in relation to treatment for rust. (J. F. J.)

1156. [ANON.] **Spraying to prevent damage by frost.** <Am. Gard., vol. XIII, New York, Apr., 1892, p. 226, ⅛ col.

States that when there is danger of a frost, if the plants be sprayed in the early morning with clear, cold water serious damage will be prevented. (J. F. J.)

1157. [ANON.] **The black knot of the plum and cherry.** <Am. Gard., vol. XIII, New York, Aug., 1892, pp. 478–480, pl. 2.

Mention of the usual methods of eradicating black knot, that is, cutting out and burning; and an outline of the New York State law passed against allowing the disease to remain in orchards. (J. F. J.)

1158. [ANON.] **The strawberry leaf disease.** <Gard. Chron., 3d. ser., vol. X, London, July 11, 1891, p. 53, fig. 1, ½ col.

Refers to disease caused by *Sphærella fragariæ* and gives as a remedy carbonate of copper 3 ounces, dissolved in 1 quart of water, diluted with 20 gallons of water; diseased leaves should also be burned. (J. F. J.)

1159. [ANON.] **The treatment of disease in plants by means of copper compound.** <Gard. Chron., 3d ser., vol. X, London, Aug. 15, 1891, p. 196, ½ col.

Refers to successful treatment of potato diseases by lime and copper sulphate; the same also used for disease of sugar beets caused by *Peronospora schachtii*. (J. F. J.)

1160. [ANON.] **Vermorel's appliances for the treatment of scale on orange trees, the pear-leaf slug, and other pests.** <Agr. Jour. Cape Colony, vol IV, Cape Town, Oct. 8, 1891, pp. 80–82.

Describes the various appliances used for both insecticides and fungicides. (J. F. J.)

1161. [ANON.] **Visit to Angaston district.** <Gard. and Field, vol. XVII, Adelaide, Feb., 1892, pp. 184–186.

Notes successful use of eau céleste in combating the shot-hole fungus of apricot trees. Pear and apple scab also treated successfully. Gives a statement of discussion on use of fungicides to prevent fungous diseases, such as scab, curl-leaf, beet disease, etc. (J. F. J.)

1162. ARMSTRONG, L. **Carnation disease.** <Am. Gard., vol. XIII, New York, Dec., 1892, p. 762, ⅓ col.

Notes that the disease can be checked by using sulphur compound, made by subjecting sulphur and quicklime to intense heat; use 1 gill of this to 2 gallons of water, and syringe the plants twice a day. Compound seems to act by promoting healthy root action. (J. F. J.)

1163. ARTHUR, J. C. **Report of the botanical department [of the Indiana Agricultural Experiment Station].** <Fourth Ann. Rept. Ind. Agr. Exp. Sta. for 1891, Feb., 1892, pp. 23–28.

Gives a brief notice of the work of the station to prevent diseases of corn, oats, wheat potatoes, beets, and carnations. (J. F. J.)

1164. BABO, C. VON. **Sulphuring vines for Oidium.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Oct. 22, 1891, p. 100, ½ col.

Gives directions for use of sulphur for Oidium, and states that rain causes it to lose its effectiveness. (J. F. J.)

1165. BARMY, DR. **Préservation contre les gelées de printemps.** <Prog. Agr. et Vit., 9th year, No. 27, Montpellier, July 3, 1892, pp. 5–6.

It has been long known that the production of artificial clouds by burning tar may prevent the killing of buds by frost in the spring. The author recommends using this treatment not only in spring, but during all the winter, when frost is expected to occur, so as to preserve the entire growth of the vineyard. (T. H.)

1166. BEDFORD, S. A. **Smut.** <Exp. Farms Rept. for 1891, Ottawa, 1892, p. 252.

Notes occurrence of smut on wheat in Province of Manitoba, and gives details of experiments made in 1889 for prevention. Bluestone gave better results than salt or scalding. (J. F. J.)

1167. BLERSCH, F. **Bluestone for steeping grain.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Sept. 10, 1891, pp. 61, 62, 1 col.

Gives formula for steeping wheat, and states that a ½ per cent solution of vitriol is strong enough to destroy smut. Does not recommend the Jensen hot-water treatment, because the difficulty of maintaining the water at the specified temperature of 132° to 135° F. (J. F. J.)

1168. BLERSCH, F. **Steeping grain in vitriol.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Aug. 27, 1891, p. 46, ½ col.

Refers to experience of Gilfillan (see No. 1187), and states his belief that the bad results from the use of vitriol were due to other circumstances, such as seed wheat passing through a threshing machine, soaking wheat too long and then sowing in dry weather, or lack of lime in the soil. (J. F. J.)

1169. "BOSTON SUBURB." **Sand and damping off.** <Am. Gard., vol. XIII, New York, Apr., 1892, p. 226, ½ col.

Says the use of a layer of sand might prevent damping off of cuttings. (J. F. J.)

1170. BRUNK, T. L. **[Spraying experiments and apparatus.]** <Fourth Ann. Rept. Md. Agr. Exp. Sta. for 1891 [College Park], 1892, pp. 381-399, figs. 7.

Describes experiments with apples to prevent depredations by insects and fungi. Gives account of various fungicides, such as ammoniacal copper carbonate solution, carbonate of copper and carbonate of ammonia, kerosene emulsion and copper carbonate (each used in combination with Paris green), and improved ammoniacal copper carbonate. Believes kerosene emulsion, copper carbonate, and Paris green mixture to be effective in combating both insects and fungi attacking apple and pear. Gives successful results of spraying watermelon, cucumber, muskmelon, pumpkin, and squash vines with Bordeaux mixture to control *Glœosporium lindemuthianum*. Tomatoes attacked by *Cladosporium fulvum* were sprayed with Bordeaux mixture and carbonate of copper mixture, but with little success. Strawberry leaf-blight was successfully treated with ammoniacal copper carbonate solution and Bordeaux mixture. Blackberry rust also treated, but without apparent success. The use of fungicides combined with grubbing out infected plants will eradicate this disease in time. Quince leaf-blight was treated successfully with Bordeaux mixture two times in early spring, and copper carbonate and carbonate of ammonia mixture two or three times in the latter part of the season. Descriptions, with illustrations, are given of various forms of spraying apparatus. (J. F. J.)

1171. BUTZ, GEO. C. **Information on spraying fruits.** <Pa. State College Agr. Exp. Sta. Bull. No. 19, State College, Apr, 1892, pp. 13, figs. 6.

Describes results of spraying to destroy both insect and fungous pests, giving formulæ for Bordeaux mixture and ammoniacal carbonate of copper, together with description and figures of various forms of pumps. (J. F. J.)

1172. CHESTER, F. D. **A few common diseases of crops and their treatment.** <Del. Agr. Exp. Sta. Bull. No. 15, Newark, Jan., 1892, pp. 16.

Discusses the present status of treatment of vine diseases by means of Bordeaux mixture, copper carbonate in suspension, copper soda hyposulphite, Johnson's mixture (copper sulphate and ammonium carbonate), and copper and ammonium carbonate mixture. Both copper soda hyposulphite and Johnson's mixture injured the foliage, while the copper and ammonium carbonate mixture it is believed promises good results. In discussion of pear leaf-blight considers that Bordeaux mixture and Paris green will give good results. In treatment of peach rot records good results from use of copper and ammonium carbonate mixture. Several diseases of potato are discussed, viz. that caused by *Phytophthora infestans* (which can be controlled by Bordeaux mixture), a bacterial disease, and one caused by *Macrosporium solani*. This last is also kept in check by Bordeaux mixture. Directions are given for the preparation of the various fungicides mentioned in the bulletin. (J. F. J.)

1173. CHESTER, F. D. **Spraying with sulphide of potassium for the scab of the pear.** <Del. Agr. Exp. Sta. Bull. No. 7, Newark, Mar., 1890, pp. 11-14.

Gives details of experiments for treatment of *Fusicladium pyrinum*. The solution of potassium sulphide had a strength of ½ ounce to a gallon of water, and the sprayed trees produced about 25 per cent more marketable fruit than the unsprayed. (J. F. J.)

1174. CHUARD, E. **Adhérence aux feuilles des plantes de composés cuivriques destinés combattre leurs maladies.** <Chron. Agr. du Canton de Vaud, vol. v, Lausanne, Mar. 10, 1892, pp. 99-101.

Refers to results obtained by Girard and notes difference in those from his own experiments. In order of adhesiveness Girard found Perret mixture to stand first, Masson mixture second, and ordinary Bordeaux mixture last. Chuard found eau céleste to be first, Masson mixture second, and Bordeaux mixture third. Believes different results arise from different formulæ used in the two cases. Experiments were made with plants attacked by *Peronospora*. (J. F. J.)

1175. COBB, N. A. **Dialogue concerning the manner in which a poisonous spray does its work in preventing or checking blight.** <Agr. Gaz. N. S. Wales, vol. II, Sydney, Dec., 1891, pp. 779-786, figs. 6.

Describes, in the form of a dialogue, blight of the rose, with its mode of growth, and method of treating it by spraying with fungicides. Deals especially with the latter subject, stating that three sprayings of three seconds each, with intervals between long enough to become dry, were more effectual in spreading the fungicide than one spraying of nine consecutive seconds. (J. F. J.)

1176. C[OOKE], J. H. **The Malta potato disease.** <Medit. Nat., vol. II, Malta, June, 1892, pp. 194-195.

Notes the destruction of potatoes caused by *Phytophthora infestans*, and states that sulphate of iron, 1 ounce to 4 gallons of water, proved an effective remedy. (J. F. J.)

1177. CRAIG, JOHN. **Annual report of the horticulturist.—Fungicides.** <Exp. Farms Ann. Rept. for 1891, Ottawa, 1892, pp. 144-148.

Gives results of experiments with fungicides for the prevention of apple scab, a modified eau-céleste solution giving the best results; for grape mildew and gooseberry mildew, potassium sulphide, 1 ounce in 3 gallons of water, gave the best results. Directions for making copper carbonate solutions are given. (J. F. J.)

1178. CRAIG, JOHN. **Apple-scab remedy.** <Orange Judd Farmer, vol. XI, Chicago, Mar. 19, 1892, p. 180, ½ col.

Gives directions for making carbonate of copper at home. (J. F. J.)

1179. DAVIS, G. C. **Benefits of lime with the arsenites.** <Farm, Field, and Stockman, vol. XV, Chicago, Feb. 27, 1892, p. 200, 1 col.

States that Bordeaux mixture in connection with arsenites is useful both as an insecticide and a fungicide. Recommends 4 pounds of lime and 2 pounds of copper sulphate to a barrel of water, adding ¼ to ½ of a pound of some arsenite to the barrel. London purple or Paris green may be used. (J. F. J.)

1180. DESPEISSIS, J. A. **Mechanical application of insecticides.** <Agr. Gaz. N. S. Wales, vol. II, Sydney, Oct., 1891, pp. 600–608, pl. 2, figs. 15.

Describes various forms of apparatus for the distribution of fungicides and insecticides. Chief among them is the "Strawsonizer" and the Vermorel spraying pump and nozzle. (J. F. J.)

1181. E.——, C. **Steeping grain in sulphur and lime.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Oct. 8, 1891, p. 84, ¼ col.

States that seed soaked in a mixture of sulphur and lime, 20 pounds of each in 100 gallons of water, produced a crop entirely free from smut. This was especially so with oats. (J. F. J.)

1182. FALCONER, [WM.]. **Gooseberry mildew.** <Meehan's Monthly, vol. II, Germantown, Pa., 1892, p. 61, ½ col.

Mulching ground may act as a partial preventive. Budding with Missouri currant increases the disease. Locality and cultivation have much to do with its presence or absence. (J. F. J.)

1183. FISCHER, A. **Remedy for the potato disease.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Oct. 22, 1891, p. 99, ½ col.

Notes good results obtained by Aimé Girard in use of Bordeaux mixture (100 parts of water, 2 parts bluestone, and 2 parts of lime). (J. F. J.)

1184. G.———, **Fungus on carnations.** <Am. Florist, vol. VII, Chicago and New York, Jan. 7, 1892, p. 462, $\frac{1}{16}$ col.

Advises coating pipes [in greenhouses] with sulphur for prevention of disease. (J. F. J.)

1185. G.——, W. W. **The potato disease question.** <Gard. Chron., 3d ser., vol. X, London, Dec. 5, 1891, pp. 671, 672, 2 cols.

Thinks it fairly established that the Bordeaux mixture is a remedy for Phytophthora. Advises the selection of seed which will produce good crops, yet with tops suitable for treatment. (M. B. W.)

1186. GARDNER, EDW. **Steeping grain in sulphur and lime.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Oct. 22, 1891, p. 95, $\frac{1}{6}$ col.

Recommends for smut, soaking in solution of 1½ pounds of sulphur, 3 pounds lime, and 4 gallons of water, letting it stand for eighteen hours, stirring it thoroughly after the first eight hours. (J. F. J.)

1187. GILFILLAN, E. T. **Steeping grain in vitriol.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, July 30, 1891, p. 18, ½ col.

States that steeping grain in vitriol for smut prevents germination, while the use of lime was very satisfactory. (J. F. J.)

1188. GILLETTE, C. P. **Experiments with arsenites. (Combining arsenites with fungicides.)** <Iowa Agr. Exp. Sta. Bull. No. 10 [Ames], Aug., 1890, pp. 416–418.

Gives details of effects of combination of arsenites and fungicides on foliage. States that London purple in combination with Bordeaux mixture did not in the least injure peach or plum foliage in proportion of 1 pound to 50 gallons of Bordeaux mixture. One pound to [illegible] gallons injured plum to an extent of 10 per cent, but apple not at all. London purple when combined with simple sulphate of copper solution was very injurious, even when used at the rate of 1 pound to 200 gallons of solution. Applied with water in this proportion, no injury would result. The arsenites when combined with ammoniacal copper carbonate are generally less injurious than when used with water alone. (J. F. J.)

1189. GOFF, E. S. **Experiment in the treatment of apple scab.** <Eighth Ann. Rept Wis. Agr. Exp. Sta., Madison, 1892, pp. 160–161.

Brief statement of results. Fungicides used were copper carbonate dissolved in ammonia and suspended in water, sulphur powder, and mixture No. 5. The last was most efficacious, but it injured the foliage. The results show that spraying before the flowers open is very important. (J. F. J.)

1190. GOFF, E. S. **Treatment of the potato blight.** <Eighth Ann. Rept. Wis. Agr. Exp. Sta., Madison, 1892, pp. 138–141, figs. 2.

Gives results of a series of experiments with Bordeaux mixture of varying strengths. The treatment was successful, as shown by an increased yield and freedom from blight (J. F. J.)

1191. [GOODELL, H. H.] **Fourth Annual Report of the Hatch Agricultural Experiment Station of the Massachusetts Agricultural College,** Amherst, Jan., 1892, pp. 14, pl. 1.

On pp. 11 and 12, under head of "horticultural division," mentions favorable results of experiments with fungicides to prevent apple scab, peach and plum rot, pear and plum leaf-blight, and potato blight and rot. No details are given. (J. F. J.)

1192. HALSTED, B. D. **Field experiments with soil and black rots of sweet potatoes.** <N. J. Agr. Exp. Sta. Special Bull. M, New Brunswick, Nov. 23, 1891, pp. 1–17, pl. 1.

Gives details of experiments, with list of manures used (see Exp. Sta. Rec., vol. III, May, 1892, p. 703). (J. F. J.)

1193. H[ALSTED], B. D. **Spraying against pear blight.** <Gard. and Forest, vol. III, New York, Oct. 15, 1890, p. 505, ½ col.

Notes the value of spraying for prevention of leaf-blight, and the saving of a considerable amount of money on the crop. (J. F. J.)

1194. HAMMOND, ——. **Spraying fruit.** <Farm, Field, and Stockman, vol. XV, Chicago, Feb. 6, 1892, p. 127, ⅔ col.

States that spraying apple trees (Wythe variety) with London purple, followed by a fungicide, caused, after a second double spraying, the leaves to fall from many trees. Ben Davis apple was not injured by a similar treatment. Vines sprayed with various solutions of sulphate of copper and sulphate of iron varied in their loss of fruit by black rot from 10 to 80 per cent. The best remedy was considered to be 2 pounds of sulphate of copper, 2½ pounds of carbonate of soda, and 1½ pints of ammonia to 40 gallons of water. Believes the latter might be increased 50 per cent. (J. F. J.)

1195. HINE, J. S. **Practical spraying at Ohio Experiment Station in 1891.** <Jour. Columbus Hort. Soc., vol. VI, Columbus, Sept., 1891, pp. 93–96.

Gives a statement of the work of the station to prevent fungous diseases and destroy insect pests. Notes that a dilute Bordeaux mixture (4 pounds of lime and 4 pounds of copper sulphate to 50 gallons of water) was as effective in preventing apple scab, leaf-spot, etc., as the old formula of 6 pounds of copper sulphate and 4 pounds of lime to 22 gallons of water. Claims the former is better for several reasons. Considers Bordeaux mixture gave the best results of any fungicide used, the dilute form giving as good effects as the other for many diseases. (J. F. J.)

1196. HUMPHREY, J. E. **Preventive treatment [of fungous diseases of plants].** <Ninth Ann. Rept. Mass. Agr. Exp. Sta. for 1891, Amherst, 1892, pp. 235–248, pl. 1.

Discusses the subject from the points of hygienic treatment and the use of fungicides, laying special stress upon good and clean cultivation. Describes the method of preparation of various fungicides, giving addresses of firms supplying chemicals, with prices. Mentions also methods of application of fungicides, and gives addresses of manufacturers of spraying pumps. Cautions the farmer against an unwise use of the fungicides, and details some experiences of those who have used the remedies recommended. In the concluding pages discusses various sorts of smut, those affecting oats, barley, wheat, corn, rye, and onions, giving directions for using the hot-water treatment [of Jensen]. The plate illustrates the forms of smut affecting various grains (J. F. J.)

1197. JAMES, JOSEPH F. **Spraying for the prevention of plant diseases.** <Sci. Am. Sup. vol. XXXIII, New York, May 2, 1892, pp. 13635–13636.

Reviews in detail the advances made in this country and elsewhere during the past twenty years in the treatment of plant diseases and the prevention of insect injuries. Considerable space is devoted to a discussion of spraying from a hygienic standpoint. (B. T. G.)

1198. JAMES, JOSEPH F. **Wheat rust and smut.** <Science, vol. XX, New York, Aug. 12, 1892, pp. 93-94, ½ col.

Calls attention to error made in Bulletin No. 83 of the experiment station of Michigan, where treatment for wheat smut is recommended for wheat rust (see also Cult. and Count. Gent., vol. LXII, Aug. 11, 1892, p. 596). (J. F. J.)

1199. JENSEN, J. L. **Hot-water treatment for fungous [sic] diseases of cereals.** <Am. Agr., vol. LI, New York, July, 1892, pp. 410–411, 1 col.

Refers to idea that this treatment will prevent rust, but does not believe it will be at all efficacious. States that difference in climate causes a difference in length of time the seed should be treated for smut, being longer in warm than in cold climates. Believes sprinkling grain before immersing in hot water preferable to soaking. In his "improved method" the basket with the hot grain is placed for two minutes in a closed box. It is then spread on the floor and stirred for some minutes with a rake. Believes it would be best not to sow grain until four days after treating. (J. F. J.)

1200. KING, WM. R. **Gum in lemons.** <Fla. Disp. Farm and Fruit Grower, n. ser., vol. IV, Jacksonville, Aug. 18, 1892, p. 645, ½ col.

Gives directions for treatment of disease, scraping off gum, cutting away diseased bark, and washing with McMaster and Miller's insecticide, also spraying with same solution. The sores were painted with shellac varnish and the trees fertilized with 10 pounds of sulphate of potash each. (J. F. J.)

1201. KINNEY, L. F. **Fungicides and insecticides.** <R. I. Agr. Exp. Sta. Bull. No. 15, Kingston, Apr., 1892, pp. 11–25, figs. 6.

Gives the formula for Bordeaux mixture and ammoniacal copper carbonate solution, also the prices for copper compounds. Describes apparatus for spraying, the knapsack sprayer and "Perfection" outfit. Discusses the use of fungicides in treating black rot of grapes, mainly by quoting from U. S. Department of Agriculture Reports, giving time of treatment and cost. For apple scab quotes from Ohio Agr. Exp. Sta. Bull. No. 9, vol. IV, n. ser., recommending dilute Bordeaux mixture (4 pounds of sulphate of copper and 4 pounds of lime to 50 gallons of water). Paris green may be used with the Bordeaux mixture as an insecticide. (J. F. J.)

1202. LODEMAN, E. G. **Combinations of fungicides and insecticides, and some new fungicides.** <Cornell Univ. Agr. Exp. Sta. Bull. No. 35, Ithaca, N. Y., Dec., 1891, pp. 315–338.

Gives details of experiments with carbonate of copper, sulphate of copper, hydrate of copper, borate of copper, and chloride of copper, all used in combination with arsenites. The results of the experiments are briefly as follows: The effect of ammoniacal carbonate of copper as a fungicide is not lessened when Paris green or London purple is added, and gave better results with 1½ ounces in 1 pint of ammonia than double the quantity in 22 gallons of water; but the combinations have a caustic effect on the foliage of most plants. Sulphate of copper with Paris green and London purple formed an unsatisfactory combination; hydrate of copper alone is not as effective as when applied with Bordeaux mixture, although it did little injury to the foliage; borate of copper has little fungicidal action and in combination with arsenites is caustic; chloride of copper gave better results than the Bordeaux mixture, but it must be weak (1½ ounces in 22 gallons of water injured the foliage of apple and peach trees). Mention is made of experiments in other places. In a note (p. ...) the formulæ for Bordeaux mixture and ammoniacal carbonate of copper are given. The only successful combination yet found is with Bordeaux mixture and the arsenites. With ammoniacal carbonate and the arsenites the foliage is usually seriously injured (see also Exp. Sta. Rec., vol. III, Washington, Mar., 1892, pp. 524–526). (J. F. J.)

1203. MARLATT, F. A. **A good spraying outfit for the general fruit-grower.** <Agr. Sup. Kansas Weekly Capital, Topeka, Mar. 3, 1892.

Mentions various spraying machines in use, and gives a list of articles, with prices, necessary for the work. Gives also addresses of firms manufacturing pumps. (J. F. J.)

1204. MAYNARD, S. T. **Experiments with fungicides and insecticides.** <Mass. Hatch Agr. Exp. Sta. Bull. No. 17, Amherst, Apr., 1892, pp. 1–32, pl. 11.

A report of work done at the station, at Northboro, and by various individuals under the direction of the horticulturist. The four fungicides used were Bordeaux mixture, ammoniacal carbonate of copper, sulphate of copper, and sulphate of iron. Short descriptions are given of the following diseases: Apple scab, pear leaf-blight, plum leaf-blight or shot-hole fungus, brown fruit rot, powdery mildew and black rot of the grape, potato rot, and black wart of plum and cherry. Experiments were made to prevent all of these, with generally good results. Paris green was used in combination with the Bordeaux mixture. The reports of the volunteer observers vary, but they note generally favorable results. Dr. Jabez Fisher describes a syringe for spraying, called by him the "Hydrospray." He also records good results in combating tomato rot by the use of 1 pound of copper sulphate in 1... gallons of water. The foliage was not injured and the spread of the fungus was checked. At Northboro, peach, plum, pear, and apple trees, grapevines, and black raspberries were treated. Bordeaux mixture injured the peach foliage, but ammoniacal solution checked the rot. Anthracnose of raspberries was successfully treated with Bordeaux mixture and copper sulphate, and potatoes were treated with Bordeaux mixture and Paris green with good results. It was also found that black knot of the plum could be destroyed by painting with "kerosene paste," made by mixing ordinary kerosene with French yellow or any other dry pigment. Crude petroleum would do equally well if thick enough not to spread over the limb (see Exp. Sta. Rec., vol. III, July, 1892, pp. 864–866). (J. F. J.)

1205. [MAYNARD, S. T.] **Outline of plans for using fungicides and insecticides for 1892.** <Mass. Hatch Agr. Exp. Sta. Bull. No. 17, Amherst, Apr., 1892, pp. 41–43.

Gives various treatments for apple, pear, plum, peach, grape, raspberry, blackberry, strawberry, and potato based on the previous year's experiments. (J. F. J.)

1206. [MAYNARD, S. T.] **Spraying apparatus.** <Mass. Hatch Agr. Exp. Sta. Bull. No. 17, Amherst, Apr., 1892, pp. 44–47, figs. 4.

Describes briefly horse apparatus, knapsack sprayers, and nozzles. Gives also statement of prices of chemicals. (J. F. J.)

1207. PAMMEL, L. H. **Experiments with fungicides.** <Iowa Agr. Exp. Sta. [Ames] Bull. No. 16, Des Moines, Feb., 1892, pp. 315–329, figs. 3.

Gives details of experiments to prevent corn smut, and records negative results when seed was treated by hot-water method. Soaking in ammoniacal copper carbonate solution gave partially favorable results, but copper sulphate the reverse. Experiments to ascertain if copper salts were injurious to vegetation were made with Bordeaux mixture, ammoniacal carbonate of copper, eau céleste, modified eau céleste, and ferrous sulphate, each in three different strengths. Injury to roots was most marked in the use of ammoniacal carbonate of copper. Rust of wheat is described and details are given of several treatments for prevention. Ammoniacal carbonate of copper and Bordeaux mixture were both used, but neither prevented rust (see Science, vol. XIX, Jan. 8, 1892, p. 23; Exp. Sta. Rec., vol. III, June, 1892, pp. 787–788). (J. F. J.)

1208. PEARSON, A. N. **Rust in wheat.** <Dept. Agr. Victoria, Bull. No. 14, Melbourne, Dec., 1891, pp. 12–15.

Mentions the results of experiments on sixty-five plats of wheat made at Port Fairy on rust in wheat. Ferrous sulphate was the only substance that had any useful effect. It was recommended, however, to sow early and use rust-resisting varieties of grain. (J. F. J.)

1209. PEARSON, A. N., ET AL., COMMITTEE. **Report on Smith Ellis's scheme for preventing rust in wheat.** <Dept. Agr. Victoria, Bull. No. 14, Melbourne, Dec., 1891, pp. 119–125.

An adverse criticism of a plan advocated by Mr. Smith Ellis to prevent wheat rust, in which it is shown that the author is not conversant with the history of the fungus causing the disease, and concluding with the statement that he had failed to satisfy any of the committee that his so-called specific was in reality such. (J. F. J.)

1210. PICHI, P. **Alcuni esperimenti fisiopatologici sulla vite in relazione al parassitismo della peronospora. Nota prima.** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, Apr. 6, 1891, pp. 361–366.

Reports on preliminary laboratory and field experiments planned with a view of ascertaining if copper sulphate may not be absorbed by the vine through the roots, and transferred to the leaves, where its presence will form an obstacle to the entrance of the hyphæ of the Peronospora. In laboratory experiment branches of healthy vines were kept in vases containing various strengths of copper sulphate solutions, together with proper controls. Both sets being treated with sowings of the zoospores of Peronospora, several of those in pure water were attacked by the parasite, while those in copper solutions were immune. In field experiments both solutions, of various strength, and the powdered copper sulphate were used, both being placed at the base of each vine, at the rate of from 2.5 grams to 1.25 kilograms per vine. The results of this treatment, while by no means proving an immunity from the disease caused by the presence of the sulphate, encourage the author in his hopes that such a method may be followed with success. Records the remarkable well-nigh impossible presence of crystals of copper sulphate in the leaves or branches maintained in a solution of the salt for twenty days. (D. G. F.)

1211. SMITH, F. C., SAGE, W., and ROBIN, A. B. **[Report of experiments on fungous diseases of fruit trees at Angaston.]** <South Australia Register, Nureootpa, Mar. 30, 1892.

Gives a summary of the results of experiments for apple and pear scab, shot-hole fungus of apricot, and peach leaf-curl. The fungicides used were ammoniacal copper carbonate solution, eau céleste, and Bordeaux mixture. Ammoniacal copper carbonate appeared to reduce apple scab. Bordeaux mixture gave the best results with shot-hole fungus of the apricot. None were useful in preventing pear scab, while all were effectual in treating peach leaf-curl. One sprayed peach tree that had for years been affected with curl was entirely free from it and produced 400 pounds of fruit. The knapsack pump is recommended for spraying. (J. F. J.)

1212. SHORE, ROBT. **Root knot on begonias.** <Am. Florist, vol. VII, Chicago and New York, Feb. 25, 1892, p. 626, ½ col.

States that there is no cure for the disease, but that it can be prevented by baking the soil or sprinkling lime with it before planting. Recommends sprinkling with limewater every eight or ten days. (J. F. J.)

1213. SHUTT, F. T. **Report on the effect of solutions of copper sulphate (blue vitriol), iron sulphate (green vitriol), and agricultural bluestone on the vitality of seed wheat.** <Ann. Rept. Exp. Farms for 1890, Ottawa, 1891, pp. 146–148.

Gives details of treatment with solutions of varying strengths, both sulphate of iron and agricultural bluestone, this last (composed of one-third copper sulphate and two-thirds iron sulphate), seriously injuring the vitality when used in a solution of 1 pound to 8 gallons of water and immersed for thirty-six hours. Treated with the same quantity of sulphate of iron, the vitality was 96.5 as against 55.5 and 40 per cent for bluestone and sulphate of copper, respectively. Sprinkling the seed with the three solutions gave 99.0, 79.5, and 72.5 per cent, respectively. The result of the experiment shows that sulphate of iron did not materially affect the vitality of seed wheat, while copper sulphate and agricultural bluestone did. Loose smut appeared on all the plats treated. The seed was allowed to dry for thirteen days before being sown. (J. F. J.)

1214. TAFT, L. R. **Report on the experiments made in 1889 in the treatment of apple scab in Michigan.** <Mich. Agr. Exp. Sta. Bull. No. 59, Agricultural College, Apr., 1890, pp. 30–42, figs. 6.

Gives details of series of experiments made with various fungicides, such as potassium sulphide, sodium hyposulphite, sulphur solution, copper carbonate and ammonia, and modified eau céleste. Modified eau céleste gave the best results (J. F. J.)

1215. THAXTER, R. **Further results from the application of fungicides to prevent the "spot" of quince (Entomosporium maculatum).** <Ann. Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 150–152, pl. 1.

States that two rows of trees treated with Bordeaux mixture yielded 71½ baskets of marketable fruit, while two rows treated with ammoniacal carbonate of copper in 1890 and precipitated carbonate of copper in 1891 yielded only 7 baskets. Five rows untreated for two years yielded only one basket. The balance above cost of treatment with Bordeaux mixture was $49.42 (see Exp. Sta. Rec., vol. III, June, 1892, pp. 770–771). (J. F. J.)

1216. TROOP, JAMES. **Treatment of powdery mildew and black rot [of grapes].** <Purdue Univ. Agr. Exp. Sta. Bull. No. 38, vol. III, La Fayette, Ind., Mar. 19, 1892, pp. 17–18.

States that powdery mildew of greenhouse grapes is controlled by potassium sulphide, 1 ounce to 5 gallons of water, and black rot by Bordeaux mixture, giving as a formula for the latter 12 pounds of sulphate of copper and 8 pounds of lime to 45 gallons of water (see Exp. Sta. Rec., vol. III, June, 1892, p. 781; also Prairie Farmer, vol. LXIV, June 11, 1892, p. 374). (J. F. J.)

1217. VEALE, HENRY. **Vitriol dressing for grain.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Aug. 27, 1891, p. 46, ½ col.

States that wheat treated for smut should not be steeped in vitriol, but in water for six hours, and then wet down with a solution of 2 ounces of vitriol to 1 gallon of water, afterwards drying the grain with slaked lime. Quotes from New Zealand School of Agriculture in regard to fungicides for smut. (J. F. J.)

1218. W. ——, N. J. DE. **Steeping grain in vitriol.** <Agr. Jour. Cape Colony, Cape Town, vol. IV, Oct. 22, 1891, p. 95, ½ col.

Concludes that failure of seed to grow after immersion in blue stone solution was due to swollen condition of seed. Untreated seed germinates in less time than treated. (J. F. J.)

1219. WILLIS, J. J. **Bordeaux mixture as a preventive of the potato blight.** <Gard. Chron., 3d ser., vol. XI, Jan. 23, 1892, London, p. 106, 1 col.

Mentions the widespread use in the United States of Bordeaux mixture on grapes and says that its use against potato rot was suggested by the similarity of the fungus to that causing the brown rot of grapes. Gives an account of experiments in 1890 conducted by the Rhode Island State Agricultural Experiment Station on the use of Bordeaux mixture on potatoes. The results were that three sprayings increased the yield 10 per cent and five sprayings 34 per cent, the increased yield being due to the larger size of the tubers. (M. B. W.)

1220. WOOLEN, L. R. **The violet disease.** <Am. Florist, vol. VII, Chicago and New York, Feb. 11, 1892, p. 574, $\frac{1}{10}$ col.

Gives as a remedy the use of air-slaked lime or even pouring strong limewater on the plants. (J. F. J.)

1221. Z——, X. Y. **The modern remedies for the potato disease.** <Gard. Chron., 3d ser., vol. X, London, Dec. 19, 1891, p. 742, ½ col.

Thinks there is as yet no remedy for the disease. (M. B. W.)

1222. ZIRNGIEBEL, DENYS. **The violet disease.** <Am. Florist, vol. VII, Chicago and New York, Feb. 4, 1892, p. 552, ¼ col.

States that Italians combat the disease by use of Bordeaux mixture. (J. F. J.)

(See also Nos. 1010, 1021, 1035, 1037, 1045, 1047, 1056, 1058, 1059, 1065, 1068, 1070, 1071, 1072, 1078, 1079, 1080, 1081, 1083, 1084, 1085, 1086, 1088, 1089, 1090, 1093, 1095, 1096, 1100, 1105, 1106, 1107, 1108, 1109, 1111, 1113 1114, 1116, 1117, 1121, 1129, 1130, 1131, 1133, 1134, 1135, 1136, 1137, 1138, 1139.)

E.—PHYSIOLOGY, BIOLOGY, AND GEOGRAPHICAL DISTRIBUTION.

1223. [ANON.] **Heteroecismal fungi.** <Gard. Chron., 3d ser., vol. IX, London, May 30, 1891, p. 683, ½ col.

Notes the statement by Plowright that he had produced *Cæoma laricis* on the larch by infecting the tree with the teleutospores of *Melampsora betulinæ* from birch, and that Dr. Franzschel had found in Russia *Puccinia digraphidis* Soppitt growing on *Phalaris arundinacea* in vicinity of *Æcidium convallariæ*, and *P. agrostidis* on *Agrostis vulgaris* in vicinity of *Æcidium aquilegiæ*. (J. F. J.)

1224. [ANON.] **[Occurrence of Sphærotheca lanestris in Mississippi.]** <Bot. Gaz., vol. XVI, Crawfordsville, Ind., Oct. 16, 1891, p. 297.

Notes that this species, previously supposed to be confined to *Quercus agrifolia*, has been found by S. M. Tracy on various species of oak in Mississippi and by Atkinson in Alabama. (J. F. J.)

1225. [ANON.] **[Oöspores in Phytophthora infestans.]** <Gard. and Forest, vol. III, New York, Sept. 10, 1890, p. 448, ½ col.

Calls attention to paper by Smorawski in which it is stated that mycelium of the potato-rot fungus produced conidia and also oögonia-like bodies, regarded by him as antheridia. The reviewer does not consider that Smorawski's idea is fully proven by his investigations. (J. F. J.)

1226. [BEACH, S. A.] **Influence of copper compounds in soils upon vegetation.** <N. Y. State Agr. Exp. Sta. Bull. No. 41, n. ser., Geneva, Apr., 1892, pp. 35–43, figs. 3, charts 7.

Gives details of experiments with peas, tomatoes, and wheat planted in soils containing 2 and 5 per cent of copper sulphate, mentioning the differences in germination, foliage, period of maturity, number and weight of seed, root system, etc. The results point to the fact that the presence of copper in the soil in large quantities is injurious to plant growth. (J. F. J.)

1227. COBB, N. A. **Contributions to an economic knowledge of Australian rusts (Uredineæ).** <Agr. Gaz. N. S. Wales, vol. III, Sydney, Mar., 1892, pp. 181–212, figs. 13.

A continuation of an article published in some previous numbers on the subject, detailing what has been found out concerning wheat rust, discussing the wheat, soil, rust, and weather; also detailing the results of an examination of rust-resisting varieties of wheat in the structure of the cuticle, the tensile strength of the leaves, and the presence of stomata. Appendices contain measurements of the thickness of wheat leaves, width of the same, the tensile strength, and notes on the number of stomata observed. (J. F. J.)

1228. CONN, H. W. **Some uses of bacteria.** <Science, vol. XIX, New York, May 6, 1892, pp. 258–263.

A popular description of the good results arising from the presence of bacteria, especially as related to farming industries. Points out the agency of the organisms in the production of butter, cheese, beer, vinegar, etc. (J. F. J.)

1229. COOKE, M. C. **Ceylon in Australia.** <Grev., vol. XX, No. 93, Sept., 1891, London, pp. 29–30.

After stating that certain species of fungi have a world-wide distribution, the author says that other species occur only in countries far apart. As an example of this he points out that many of the species of fungi characteristic of Ceylon occur also in Australia. A number of species are cited, these being mostly large forms, such as Polyporei, Agaricini, etc. (M. B. W.)

1230. DETMERS, FREDA. **A fungous enemy of plant lice.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, Mar., 1892, pp. 14–16.

Describes *Empusa aphidis* as affecting various species of Aphis occurring on lettuce, radishes, chrysanthemums, etc. Believes the disease would be economically valuable if it could be introduced among plant lice affecting grain fields. (J. F. J.)

1231. DUFOUR, J. **Einige Versuche mit Botrytis tenella zur Bekämpfung der Maikäferlarven.** <Zeitsch. f. Pflanzenkrank., vol. II, Stuttgart, 1892, pp. 2–9.

Several experiments are described to show the possibility of infesting larvæ of the May beetle with Botrytis. The fungus was taken from pure cultures upon potato and from dead larvæ which had been killed by the fungus. The result shows that infection can take place from living larvæ, but the spreading of the infection, especially in the field experiments, was less than stated by French authors. Many larvæ were observed to be able to resist the infection for the three months during which the experiments were made. (T. H.)

1232. DUGGAR, B. M. **Germination of the teleutospores of Ravenelia cassiæcola.** <Bot. Gaz., vol. XVII, Bloomington, Ind., May 17, 1892, pp. 144–148, pl. 2.

Describes the general characters of the teleutospores and their germination and growth. (J. F. J.)

1233. [HUDSON, A. S.] **Force of mushroom growth.** <Pop. Sci. Monthly, vol. XXXIX, New York, Aug., 1891, p. 575, ½ col.

Refers to growth of mushrooms through a cement, asphalt, and gravel floor in a stable. One specimen came from an inch and a quarter below the surface. Where a second forced its way up the fragment of cement displaced by it was found a foot away. (J. F. J.)

1234. KOBERT. **Ueber Giftpilze.** <Sitzungsber. d. Natur. Ges. d. Univ. Dorpat, vol. IX, Dorpat, 1892, pp. 535–554.

The author divides the cases of poisoning according to the various fungi which cause it, but includes merely those cases that are known from the Baltic Provinces. One group comprises poisoning by fungi, which contain muscarin, e. g. *Agaricus muscarius* and *Boletus luridus;* other cases are due to the milky juice of the species of *Lactarius* or of *Helvella*, which contains an acid named helvellic acid. The fourth group includes such as are due to *Amanita phalloides*, one of the most dangerous, since it looks very much like the edible *Agaricus campestris*. The author discusses at length the effect and the character of the diseases (see review by Em. Bourquelot, "Matières toxiques contenues dans les champignons vénéneux," in Bull. Soc. Mycol. France, vol. XIII, Paris, Mar. 31, 1892, p. 40). (T. H.)

1235. SNOW, F. H. **Contagious diseases of the chinch bug.** <First Ann. Rept. Direc. Exp. Sta. Univ. Kan. for 1891, Topeka, Apr., 1892, p. 230, pl. 4, 1 map.

A detailed account of experiments conducted on diseases of the chinch bug, giving the laboratory observations and experiments, reports of field agents, estimates of value of crops saved, statement of effect of meteorological conditions, history of microphytous diseases of the bug, and a bibliography. The two fungi mainly relied upon, though not in pure cultures, are *Sporotrichum globuliferum* and *Empusa aphidis*. The mode of growth of these is described. Pure cultures of the former did not produce the disease in inoculated chinch bugs (p. 27). It was not possible to obtain pure cultures of *Empusa*, and no attempts at inoculation were made. A bacterial disease caused by *Micrococcus insectorum* was present and was communicated from infected to healthy bugs. The amount saved to 482 farmers is estimated in cash to be $87,244.10, and in the same ratio to the 1,066 successful experiments, $193,308. Pages 192–217 are occupied by a history of the diseases of the bug in the United States, therein are given extracts from many papers (see Exp. Sta. Rec., vol. III, June, 1892, pp. 833–835). (J. F. J.)

1236. WARD, H. M. **The ginger-beer plant and the organisms composing it: A contribution to the study of fermentation yeasts and bacteria.** <Proc. Roy. Soc., London, vol. L, Jan. 20, 1892, pp. 261–265. Phil. Trans. Roy. Soc., London, vol. CLXXXIII, Sept. 26, 1892, pp. 125–197, pl. 6, figs. 6.

The author has investigated a remarkable compound organism concerned in the fermentation of home-made ginger beer, and the article is a brief notice of the work. The organism occurs as jelly-like yellowish white masses aggregated into brain-like clumps. It resembles the so-called *Kephir* yeast, but is not identical with it. The masses consist of a symbiotic association of specific yeasts and bacteria, morphologically comparable to lichens. Besides the essential species, other species of yeasts, bacteria, and mold fungi are casually associated. The various organisms were isolated by culture methods. The essential organisms are a yeast, *Saccharomyces pyriformis* n. sp., and a bacterium, *B. vermiforme* n. sp. Both are described. Two other forms are always found, *Mycoderma cerevisiæ* and *Bacterium aceti*. The author has reconstructed the "ginger-beer plant" by mixing pure cultures of the two first-named plants. The action of plants thus synthetically produced is the same as the original, while the action of the bacteria alone on a saccharine medium differs from that exerted when it is associated with the yeast and from that exerted by the latter alone. (M. B. W.)

1237. WEBER, H. A. **Analyses of mushrooms.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, Mar., 1892, p. 12.

Gives a table of analyses of mushrooms, morels, and white truffles. (J. F. J.)

(See also No. 1117.)

F.—MORPHOLOGY AND CLASSIFICATION OF FUNGI.

I.—GENERAL WORKS.

1238. [ANON.] **Memorabilia.** <Grev., vol. XX, No. 93, Sept., 1891. London, p. 22.

Six species not in Saccardo's Sylloge, *Strobilomyces polypyramis* Hook., *Colletotrichum microspermum* Corda, *Zasmidium cellare* Fr., *Alytosporium fulvum* Fr., *A. croceum* Schw., and *A. peteridicola* Schw. *Triposporium cristatum* Patouillard is a synonym of *Speira...sis tessarthra* (B. & C.). (M. B. W.)

1239. BAILEY, F. M. **Botany. Contributions to the Queensland flora: Fungi.** <Queensland Dept. of Agr. Bull. No. 7, Brisbane, Mar., 1891, pp. 33–36.

Contains descriptions of species of fungi new to the Queensland flora. (J. F. J.)

1240. BAILEY, F. M. **Contributions to the Queensland flora.** <Queensland Dept. of Agr. Bull. No. 18, Brisbane, May, 1892, pp. 36.

On pp. 34–36 are given names of species of fungi new to the colony. No new species are described. (J. F. J.)

1241. BAILEY, F. M. **[Report of the colonial botanist.]** <Ann. Rept. Dept. Agr. Queensland for 1890–'91, Brisbane, 1891, pp. 40–48.

Mentions three species of fungi found in the Bellenden-Ker expedition and five blights observed to have injured plants during the year. (J. F. J.)

1242. BERLESE, A. N. **Icones fungorum ad usum sylloges saccardianæ adcomodatæ. Fasc. I-III**, pp. 1-118, pl. I-CXXIII, Patavii, 1890-'92.

Descriptions and illustrations of fungi given by Saccardo, with references to literature and descriptions of new species as follows: *Lophiostoma parvulum*, *L. nigricans*, *Lophidiopsis* n. gen., with *L. nuculoides* (Rehm) as the type; *Titania* n. gen., with *T. berkleyi* proposed for *Diatrype titan* B. et Br.; *Passeriniella* n. gen., with *P. dichroa* (Pass) as type; *Leptosphæria socialis*, in stems of *Asparagus officinalis*; *L. kunzeana* in stems of *Typha latifolia*; *L. ellisiana* in dead stems of *Œnothera biennis*, proposed for *L. subconica* Ellis; *L. hanzslinskyana* in stems of grasses; *L. rhopalispora*; *L. acutiuscula*, proposed for *L. acuta* Rehm; *Leptosphæriopsis* n. gen., with *Lept. ophioboloides* Sacc. as type. *Gnomoniopsis* n. gen., with *G. chamæmori* (Fr.) as type; *Winterella* n. gen., with *W. tuberculifera* (Ell. and Ev.) as type. (J. F. J.)

1243. COOKE, M. C. **Australian fungi.** <Grev., vol. XX, No. 93, Sept., 1891, London, pp. 4-7.

Gives descriptions of the following new species: *Strobilomyces ligulatus*. *S. fasciculatus*, *Hypocrella axillaris*, on grasses; *Phyllachora maculata* on *Eucalyptus*; *Dothidella inæqualis* on *Eucalyptus*; *Montagnella rugulosa* on *Eucalyptus*; *Physalospora microsticta*; *Trabutia parvicapsa* on Acacia *Anthostomella lepidospermæ* on *Lepidosperma*; *Sphærella crypta* on *Eucalyptus*; *Dimerosporium parvulum* on *Trema aspera*; *Asteromella epitrema* on *Trema aspera*; *Piggotia substellata* on *Eucalyptus*; *Leptothyrium aristatum* on *Eucalyptus*; *Stagonospora orbicularis* on *Eucalyptus*; *Stilbospora foliorum* on *Eucalyptus*; and *Strumella patelloidea*. (Cont. from vol. XIX, p. 92. See No. 555.) (M. B. W.)

1244. COOKE, M. C. **Australian fungi. Supplement to handbook.** <Grev., vol. XXI, London, Dec., 1892, pp. 35-39.

The following new species are described, all but three (as noted) described by Cke. and Mass.: *Agaricus* (*Lepiota*) *membranaceus*, *A.* (*Clitopilus*) *cyathoideus*, *A.* (*Hebeloma*) *griseus*, *A.* (*Tubaria*) *strigipes*, *A.* (*Hypholoma*) *discretus*, *Bolbitius candidus*. *Marasmius subroseus*, *Lenzites bifasciatus*, *Polyporus* (*Orini*) *mylittæ*, *Dædalea illudens*. *Hydnum* (*Resup.*) *calcareum*, *Stereum pannosum*, *Cyphella longipes*, *Stephensia arenivaga*, *Diploderma sabulosum*. *Sphærella goodiæfolia* Cke., on leaves of *Goodia latifolia*. *Oöspora rutilans*, *Monotospora fasciculata*, *Cercospora glycines* Cke., on leaves of *Glycine clandestina*; *Hymenula eucalypti* on leaves of *Eucalyptus*; and *Phyllosticta prostantheræ* Cke., on leaves of *Prostanthera lasianthos*. (J. F. J.)

1245. COOKE, M. C. **Exotic fungi.** <Grev., vol. XX, No. 93, London, Sept., 1891, pp. 15-16.

Describes these new species of fungi: *Cordyceps sceerigini* Mass. on ant (*Formica*), *Sphærostilbe macowani* (Korb.), and *Uredo* (*Uromyces* (?)) *aloes*. (M. B. W.)

1246. COOKE, M. C. **Mushrooms and toadstools.** <Grev., vol. XIX, London, March, 1891, pp. 83-84.

Discusses the numbers of edible and poisonous British species of fungi. (M. B. W.)

1247. COOKE, M. C. **New British fungi.** <Grev., vol. XX, No. 93, London, Sept., 1891, p. 8.

Describes *Kalmusia stromatica* Cke. & Mass., *Coryneum cammelliæ* on *Camellia*. *Ramularia petuniæ* on Petunia. (M. B. W.)

1248. COOKE, M. C. **New Zealand fungi.** <Grev., vol. XXI, London, Sept., 1892, p. 1.

Describes new species as follows: *Rhizopogon violaceus* Cke. & Mass. on ground. *Chromosporium pallescens* Cke. & Mass. among mosses, *Camarosporium solandri* on twigs of *Fagus solandri*. (J. F. J.)

1249. [ELLIS, J. B., AND ANDERSON, F. W.] **New species of Montana fungi.** <Bot. Gaz., vol. XVI, Crawfordsville, Ind., Mar. 16, 1891, pp. 85-86, pl. 1.

Gives description of plate illustrating article in February number, the two species illustrated being *Sporidesmium sorisporioides* E. & A. and *Æcidium liatridis* E. & A. (see No. 257). (J. F. J.)

1250. M[ASSEE,] G. **Memorabilia.** <Grev., vol. XIX, London, June, 1891, p. 108.

Notes that *Thelephora suffulta* B. & Br., *T. retiformis* B. & C., and *T. reticulata* B. & C. are all forms of *T. pedicellata* L. Notices that a book on "British Edible Fungi," by M. C. Cooke, is in press. Also a note on *Emericella variecolor* B. & Br. and *Inzengaeca erythospora* Borzi, the latter having been described by Harkness through mistake as a new genus, *Thelospora*. (M. B. W.)

1251. ROSTRUP, E. **Tillæg til "Grœnlands Svampe, 1888."** <Meddelelser om Grœnland, vol. III, Copenhagen, 1891, pp. 593-643.

Enumeration of fungi collected in Greenland since 1888. Some new species are described. *Hymenomycetes* 58 sp., new—*Cyphella lateritia*; *Gasteromycetes* 2 sp.; *Tremellaceæ* 5 sp.; *Ustilagineæ* 4 sp.; *Uredinaceæ* 3 sp.; *Taphrinaceæ* 1 sp.; *Discomycetes* 46 sp., new, *Cudionella fructigena*, *Neottiella vitellina*, *Sclerotinia vahliana*, *Phialea macrospora*. *Mollisia alpina*, *Cenangella hartzii*, *Godronia juniperi*, *Phacidium polygoni*, *Trochila rhodiolæ*, *Pseudopeziza axillaris*, *Glonium betulinum*; *Pyrenomycetes* 57 sp., new, *Læstadia alchemillæ*. *L. potentillæ*, *Apiospora rosenvingei*, *Coleroa oxyriæ*, *Leptosphæria brachysca*, *Melanomma sali*

1251. ROSTRUP, E.—Continued.

cinum, *Acanthostigma alni*, *Pleospora vitrea; Sphæropsideæ* 23 sp., new, *Phyllosticta* ... *Phoma hieracii*, *Septoria pyrolata*, *Dinemasporium galbulicola; Gymnomycetes* (*Melanconieæ*) 13 sp., new, *Melanostroma sorbi; Hyphomycetes* 17 sp., new, *Cercosporella* ... *Heterosporium stenhammariæ*, *Dendrodochium betulinum; Zygomycetes* 1 sp.; *Entom*... *thoraceæ* 1 sp.; *Saprolegniaceæ* 1 sp.; *Peronosporaceæ* 1 sp.; *Chytridiaceæ* 1 sp., new, *Physoderma hippuridis*. Of sterile mycelia 8 species were found, of which *Sclerotium bacca*... is new. (T. H.)

1252. TRAIL, J. W. H. **Report for 1890 on fungi of east of Scotland.** <Scottish Naturalist, No. 31, Perth, Jan., 1891, pp. 31–35.

Lists of fungi from the Provinces of Forth, Tay, and Dee, comprising *Uredineæ*, *Ustilagineæ*, *Pyrenomycetes*, *Ascomycetes*, *Perisporiaceæ*, *Peronosporeæ*, *Hyphomycetes*, *Discomycetes* and *Gastromycetes*, with host plants, dates, and brief notes on some of the species. (M. B. W.)

1253. WHYMPER, EDW. **Travels amongst the great Andes of the Equator, with maps and illustrations.** 8vo. New York, 1892, pp. xxiv, 456.

On page 199 notes the occurrence on Antisana, at an elevation of 13,000 feet, of *Omphalia umbellifera* Fr. and *Psilocybe* sp. On pages 209 and 352 mentions finding of *Cantharellus whymperi* Massee & Murray on Pichincha at an elevation of 15,300 feet. (J. F. J.)

III.—OOMYCETES.

1254. WILLIAMS, THOS. A. **Notes on Peronosporaceæ.** <Bull. Torrey Bot. Club, vol. XIX, New York, Mar. 5, 1892, pp. 81–84.

Gives notes on species of *Peronospora*, *Sclerospora*, *Plasmopara*, and *Cystopus*, found in the vicinity of Brookings, S. Dak. A table is also given showing the rainfall during the summer months of 1890 and 1891. (J. F. J.)

V.—BASIDIOMYCETES.

1255. [ANON.] **[Edible Agaricini.]** <Bot. Gaz., vol. XVI, Crawfordsville, Ind., May 16, 1891, p. 157.

Notes that of the 1,400 species of Agaricini in Great Britain 134 are edible, 30 are poisonous, and of 516 nothing is known. The balance are too small, too tough, or too rare to be of value. (J. F. J.)

1256. [ANON.] **Notes on Tremellini.** <Grev., vol. XX, No. 93, London, Sept., 1891, p. 15.

List of species of *Dacryomyces* and *Peziza*, not in Saccardo's Sylloge, and descriptions of new of *Auricularia corium* Berk. in Herb., and *A. epitrichia* Berk. in Herb. *Tremella* ... *cina* Mull. is mentioned as being the same as *T. sarcoides*. (M. B. W.)

1257. [ANON.] **Revue horticole.** <Nouv. Ann. Soc. Hort. Gironde, No. 55, Bordeaux, Sept., 1891, pp. 152–153.

Contains a note on the importance of mushroom culture in the environs of Paris, with brief account of manner of growing. (M. B. W.)

1258. [ANON.] **Trametes trogii Berk.** <Grev., vol. XXI, London, Dec., 1892, pp. 45–46.

Refers to paper in Jour. de Bot. by M. P. Hariot in which it is concluded that *Trametes hispida* and *T. trogii* are identical. States that this conclusion is erroneous, inasmuch as Hariot had not seen the type specimen of *T. trogii*. Gives a description of the specimen, and says it is quite distinct from *T. hispida*. (J. F. J.)

1259. BOURQUELOT, EM. **Le "toboshi," champignon du Japon analogue à l'Agaric blanc des pharmacies.** <Bull. Soc. Mycol. France, vol. VIII, Paris, Mar. 31, 1892, p. 39.

The inhabitants of Yeso designate under the name "toboshi" a mushroom that grows on trunks of larch (*Larix leptolepis*). This is a species of *Polyporus*, about the size of ... fist. They prepare of it a remedy against the sweating of phthisic patients. It contains resin and an acid, the last of which is not, however, identical with agaric acid. (T. H.)

1260. BOUDIER AND PATOUILLARD. **Note sur une nouvelle Clavaire de France.** <Bull. Soc. Mycol. France, vol. VIII, May 22, 1892, pp. 41–43, pl. 1.

Describes *Clavaria geoglossoides* Boud. et Pat. as a new species. It was found growing together with *C. inæqualis* and *C. similis*. According to the description and the figure it shows a striking resemblance to a *Geoglossum*, but has the principal characters in common with the genus *Clavaria*. (T. H.)

1261. BRITZELMAYR, M. **Das Genus Cortinarius.** <Bot. Centralbl., vol. LI, Cassel, June 28, July 12, 1892, pp. 1-9, 33-42.

Among the characters which seem to be constant for this genus is the manner in which the lamellæ are attached to the pileus, as well as the color, the shape, and the size of the spores. The author enumerates the species arranged according to the system of Fries, and adds to each the size of the spores, besides giving descriptions of several of his own species. The following new species are described: *Cortinarius largiusculus*, *C. disputabilis*, *C. percognitus*, *C. extricabilis*, *C. vesperus*, *C. politulus*, *C. opimatus*, *C. albidocyaneus*, *C. fusco-violaceus*, *C. collocandus*, *C. effictus*, *C. submyrtillinus*, *C. melleifolius*, *C. subinfucatus*, *C. abiegnus*, *C. inurbanus*, *C. fulvo-cinnamomeus*, *C. fagineti*, *C. subcarnosus*, *C. assumptus*, *C. quæsitus*, *C. divulgatus*, *C. illepidus*, *C. luxuriatus*, *C. benevalens*, *C. multivagus*, *C. fistularis*, *C. blandulus*. Gives also several critical notes on the species named by Fries, which are enumerated in the list. (T. H.)

1262. COOKE, M. C. **British Tremellineæ.** <Grev., vol. XX, No. 93, London, Sept., 1891, pp. 16-22.

A revision of the British species of this family, with characterization of the family, subfamilies, genera, and species. (M. B. W.)

1263. COOKE, M. C. **New British fungi.** <Grev., vol. XX, No. 93, London, Sept., 1891, p. 25.

Descriptions of *Agaricus (Flammula) aldridgii* Massee and *Paxillus subinvolutus* Batsch. (M. B. W.)

1264. COOKE, M. C. **Notes on Clavariei.** <Grev., vol. XX, No. 93, London, Sept., 1891, pp. 10-11.

Critical notes on several species of *Clavaria*, *Calocera*, and *Lachnocladium*, with description of *Clavaria muelleri*, *C. tasmania*, *Lachnocladium kurzii* Berk. in Herb. *L. rubiginosum* Berk. & Curt. in Herb., *L. hookeri* Berk., and *Acurtis giganteum* are said not to be good species. (M. B. W.)

1265. COOKE, M. C. **Notes on Thelephoriæ.** <Grev., vol. XX, No. 93, London, Sept., 1891, pp. 11-13.

A list of species, with notes and locations, of *Hymenochæte*, *Peniophora*, *Corticium*, and *Conophora*. *Hymenochæte scrufosa* Mass. in Herb., *Corticium compactum* B. & C. in Herb., and *C. nigrescens* B & C. in Herb. are described as new. (M. B. W.)

1266. COOKE, M. C. **Species of Cyphella.** <Grev., vol. XX, No. 93, London, Sept., 1891, p. 9.

A list of twelve species not included by Saccardo in his Sylloge, with descriptions of four new species: *C. fumosa* on Gladiolus, *C. fuscospora* Currey in Herb., *C. australiensis*, and *C. texensis* Berk. & Curt. in Herb. (M. B. W.)

1267. DELOGNE, C. H. **Les Boteles, analyse des espèces de Belgique et des pays voisins, avec indication des propriétés comestibles ou vénéneuses.** <Bull. Soc. Belg. de Micr., t. XVII, Brussels, Feb., 1891, pp. 70-87.

Gives the characters of the genera *Boletinus*, *Boletus*, *Girodon*, *Strobilomyces*, and *Phylloporus*, with descriptions of the species. The article has special reference to distinguishing the poisonous and edible species. (M. B. W.)

1268. MORGAN, A. P. **Myriostoma coliforme, Dicks, in Florida.** <Am. Naturalist, vol. XXVI, Philadelphia, Apr., 1892, pp. 341-342.

Notes the occurrence of this species as found by L. M. Underwood near Eldorado, Fla. Describes the internal structure, concluding that probably *Geaster columnatus* is the same species. (J. F. J.)

1269. MORGAN, A. P. **North American fungi, fifth paper. The Gastromycetes.** <Jour. Cin. Soc. Nat. Hist., vol. XIV, Cincinnati, Oct., 1891 to Jan., 1892 [Mar. 5, 1892], pp. 141-148, pl. 1.

Describes new genera and species, as follows: *Bovistella* n. gen., *Catastoma* n. gen., *C. pedicellatum*, *Bovista montana*, *B. minor*, and gives besides descriptions of old species belonging to various genera. (J. F. J.)

1270. TOWNSHEND, N. S. **Mushrooms for the table.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, Mar., 1892, pp. 6-8.

Describes briefly the appearance of various species of edible mushrooms (Agaricus, Morchella, truffle, and puff ball), giving directions for cooking, and a short statement of how to distinguish edible from poisonous species. (J. F. J.)

1271. TURNER, W. S. **Mushroom culture.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, Mar., 1892, pp. 8-10.

Gives directions for preparing beds for mushroom cultivation, with an estimate of the probable money value of the product. (J. F. J.)

VI.—UREDINEÆ.

1272. DETMERS, FREDA. **A preliminary lirt of the rusts of Ohio.** <Ohio Agr. Exp. Sta. Bull. No. 44, Columbus, Sept., 1892, pp. 133–140.

Gives a list of species of *Uromyces*, *Puccinia*, *Phragmidium*, *Gymnosporangium*, *Melampsora*, *Coleosporium*, *Cæoma*, and *Æcidium*, together with notes on hosts and localities. (J. F. J.)

1273. DIETEL, P. **Zur Beurtheilung der Gattung Diorchidium.** <Ber. d. Deutsch. Bot. Ges., vol. x, Heft 2, Berlin, Mar. 23, 1892, pp. 57–63, figs. 2.

A revision of the genus *Diorchidium* and a discussion of several of the species formerly described by Magnus. The author's opinion is that while the genus *Diorchidium* is probably not tenable, because there are transition fo ns into *Puccinia*, he would nevertheless retain it for the present, because the distinction between other genera (*Uromyces* and *Puccinia*) are quite as artificial. For the present, therefore, he would include in *Diorchidium* species in which the majority of the spores have the septum perpendicular upon the pedicel. The genus *Sphenospora* is, however, established by the author for *Diorchidium pallidum* much on account of the differences in the development of the spores. It is characterized by having no endospore and consequently no germ pores are formed before germination. Only when germination has taken place are the places indicated through which the contents of the spore has come out. (T. H.)

1274. KLEBAHN, H. **Bemerkungen über Gymnosporangium confusum Plowr. und G. sabinæ (Dicks.).** <Zeitsch. f. Pflanzenkrank., vol. II, Heft 2, Stuttgart, 1892, pp. 94–95.

The author states the discovery of *Gymnosporangium confusum* in the vicinity of Bremen. It has been shown by culture that this fungus developed abundant æcidia upon *Cratægus oxyacantha*. According to Dr. Focke, this fungus has existed near Bremen since 18.. There had been planted a number of varieties of *Cratægus* that were badly injured by *Ræstelia*, while numerous pear trees in the same garden did not show any sign of fungous disease. (T. H.)

1275. KLEBAHN, H. **Zur Kenntniss der Schmarotzer-Pilze Bremens und Nordwestdeutschlands, Zweiter Beitrag.** <Abhand. des Natur. Ver. Bremen, vol. XII, Bremen, May, 1892, pp. 361–376.

Ninty-six species of fungi are known from the vicinity of Bremen, among which *Puccinia* is represented by 43, *Uromyces* 11, *Melampsora* 9, and some others scarcely at all. The paper contains remarks upon some of the important forms, such as *Lagenidium*, *Syncytium* n. sp. *ad interim* of the family *Ancylistaceæ*. This fungus is merely known in the sporangium form and occurs in *Œdogonium boscii*. A new variety of *Puccinia perplexans* is described, namely, *arrhenatheri*, found upon *Arrhenatherum elatius* and a variety *...cola*, of *Phragmidium rubi*. *Peridermium pini* is rare in the northwestern parts of Germany and the author mentions that the teleutosporic form is still unknown. The spermogonia of *Peridermium* showed some differences when the fungus has been taken from *Pinus strobus* or *P. sylvestris*. Those of the last do not cause any swelling of the branches and they are only visible when the bark has been removed. They then show as yellow spots, but the microscopic structure is almost the same as in *P. strobi* The peculiar odor observed in the spermogonia of *P. strobi* was not found in *P. pini*. (T. H.)

1276. THAXTER, R. **The Connecticut species of Gymnosporangium (cedar apples).** <Ann. Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 161–165.

Discusses the connection between cedar apples and rust of fruit trees. Mentions species found in Connecticut and describes development. Notes experiments to determine the history of the "bird's-nest" form and describes as a new species *Gymnosporangium nidus-avis* (see No. 310). (J. F. J.)

(See also No. 1227.)

VIII.—ASCOMYCETES.

a.—Gymnoasci.

1277. BOUDIER, EM. **Description de deux nouvelles espèces de Gymnoascus de France.** <Bull. Soc. Mycol. France, vol. VIII, May 22, 1892, pp. 43–45, pl. 1.

Gymnoascus umbrinus and *G. bourqueloti* are described and figured as new. (T. H.)

b.—Perisporiaceæ.

1278. BOMMER, CH. **Un champignon pyrénomycète se développant sur le test des Balanes.** <Bull. Soc. Belg. de Micr., t. XVII, Brussels, May 30, 1891, pp. 151–154.

Describes *Pharacidiea marina*, which is found growing on living *Balanus balanoides*. The most remarkable thing about the species is the symbiotic relation between its mycelium and unicellular algæ (Chroococcaceæ) which the author has described. (M. B. W.)

1279. CHATIN, A. **Nouvelle contribution à l'histoire de la truffe (Tirmania cambonii). Terfas du Sud algérien.** <Comp. Rend., vol. CXIV, Paris, June 13, 1892, pp. 1397-1399.

Tirmania cambonii is a new species from Algeria, closely related to *T. africana*, but differing from it by its finely veined flesh and the larger asci and spores. The spores also contain an oily matter in large quantity. The following truffles have so far been observed in Algeria: *Terfezia leonis*, *T. boudieri*, *T. claveryi*, *Tirmania africana*, and *T. cambonii*. (T. H.)

c.—Sphæriaceæ.

1280. ATKINSON, GEO. F. **On the structure and dimorphism of Hypocrea tuberiformis.** <Proc. Am. Asso. Adv. Sci. for 1891, vol. XL, Salem, Mass., July, 1892, p. 320.

Abstract giving a statement of various papers published on the subject. Notes that both perfect and conidial stages have been found by the author in Alabama. These are described. The opinion is expressed that the species should be placed, pending further study, in the genus *Hypocrella*, and be known as *Hypocrella tuberiformis* (B. & Rav.) (see No. 611). (J. F. J.)

1281. BAUMANN, E. **Ueber Cordyceps robertsii Berk.** <Ber. d. Schweizer. Bot. Ges., vol. II, Basel and Genf, 1892, p. 70.

This fungus was parasitic upon the pupa of *Hepialus virescens* from New Zealand. (T. H.)

d.—Discomycetes.

1282. [ANON.] **Morels.** <Gard. Chron., 3d ser., vol. IX, London, Apr. 18, 1891, pp. 504-506, fig. 1.

Figure of the fungus. (M. B. W.)

1283. BOUDIER, EM. **Note sur les Morchella bohemica Kromb. et voisins.** <Bull. Soc. Mycol. France, vol. VIII, Paris, July 21, 1892, pp. 141-144.

Morchella bohemica was first described and figured by Krombholtz in 1828; it was referred to the genus *Morchella*. Other authors placed the species under the genus *Verpa*, but Boudier prefers to arrange it as a subgenus of *Verpa*, viz. *Ptychoverpa*. There are some differences from the true *Verpæ*, which consist in the morchelloid aspect of the fungus, the few-spored thecæ, and the size and shape of the spores. *Morchella bispora* and *M. gigaspora* are probably not distinct species, but rather represent forms of the above. (T. H.)

1284. PHILLIPS, WM. **New Discomycetes from Orkney.** <Scottish Naturalist, No. 32, Apr., 1891, Perth, pp. 89-91.

Describes the following new species: *Hymenoscypha symphoricarpi*, *H.* (*Niptera*) *cinerella* Sacc., forma *cæspitosa*, *Lachnella orbicularis*, *L. brunneociliata*, *L.* (*Helotiella*) *laburni*, and *Cenangium empetri*, with descriptions of two other species. (J. F. J.)

IX.—IMPERFECT AND UNCLASSIFIED FORMS.

a.—Hyphomycetes and Stilbeæ.

1285. MORGAN, A. P. **Two new genera of Hyphomycetes.** <Bot. Gaz., vol. XVII, Bloomington, Ind., June 15, 1892, pp. 190-192, figs. 2.

Describes *Cylindrocladium* n. gen. and *C. scorparium* n. sp. on pod of *Gleditschia triacanthos*, and *Synthetospora* n. gen. and *S. electa* n. sp. on *Peziza* sp. (J. F. J.)

b.—Sphæropsideæ and Melanconieæ.

1286. [ANON.] [**Greeneria fuliginea.**] <Bot. Gaz., vol. XVI, Crawfordsville, Ind., Feb. 15, 1891, p. 60.

Notes change of position in classification of the species. According to Cavara it belongs with the *Melanconieæ* instead of *Sphæropsideæ*, and should be called *Melanconium fuligineum* (Scrib. & Viala) Cavara. Specific characters are given. (J. F. J.)

G.—MORPHOLOGY AND CLASSIFICATION OF BACTERIA.

1287. BALL, V. M. **Essentials of bacteriology; being a concise and systematic introduction to the study of microorganisms for the use of students and practitioners.** Philadelphia, 1891, pp. 159, figs. 77.

Discusses the classification of bacteria and gives an outline of the various schemes of classification. Notes the various forms assumed and the effect produced by bacteria on living organisms. Gives methods of examinations and of staining, and formulæ for various reagents; methods of culture; descriptions of various media employed; modes of inoculation, growth, and appearance of colonies; special modes of cultivation; and effects of bacteria on animals. In part two, discusses special bacteriology, describing diseases due to the organisms, and in appendix gives an account of yeasts and moulds, with methods of examination. (J. F. J.)

1288. WARD, H. MARSHALL. **On the characters or marks employed for classifying the Schizomycetes.** <Ann. of Bot.. vol. VI, London, Apr., 1892, pp. 103–144.

Gives a brief outline of the history of the classification of bacteria, presenting in tabular form the various schemes proposed, as follows: Cohn in 1875, Winter in 1881, Van Tieghem in 1884, Flügge in 1886, Hueppe in 1886 and later, Zopf in 1885, De Toni in 1889, Miquel in 1891, and Woodhead in 1891. Each of these is briefly discussed. Suggests in conclusion that in the future notes be made on habitat, nutrient medium, gaseous environment, temperature, morphology and life history, special behavior, and pathogenic effects. (J. F. J.)

(See also Nos. 1228, 1236.)

J.—TECHNIQUE.

1289. ARTHUR, J. C. **Cultivating the ascosporous form of yeast.** <Bot. Gaz., vol. XVII, Bloomington, Ind., Mar. 17, 1892, pp. 92–93.

Describes a method used to successfully cultivate yeast spores according to a plan recommended by Hansen. (J. F. J.)

1290. ATKINSON, GEO. F. **An automatic device for rolling culture tubes of nutrient agar-agar.** <Bot. Gaz., vol. XVII, Bloomington, Ind., May, 1892, pp. 154–156, pl. 1, fig. 1.

Describes method of making an apparatus for keeping culture tubes in motion. (J. F. J.)

1291. CHESTER, F. D. **A new culture cell.** <Micros. Bull., vol. IX, Philadelphia, Aug., 1892, pp. 25–26, fig. 1.

Describes a cell designed by N. A. Cobb for the study of the growth of microscopic fungi. (J. F. J.)

1292. RUSSELL, H. L. **The effect of mechanical movements upon the growth of certain lower organisms.** <Bot. Gaz., vol. XVII, Bloomington, Ind., Jan. 20, 1892, pp. 8–15.

Describes apparatus for experiment and gives details of the results. The species experimented with were *Monilia candida*, *Oidium albicans*, and *Saccharomyces mycoderma*. The results showed more rapid growth in the agitated than in the stationary flask, but a greater amount of alcohol was found in the latter than the former. The increase in growth in the agitated flask is apparently due to more perfect aeration and better nutrition. (J. F. J.

ERRATA.

On page 215 the following corrections should be made in table 6, in the column ving "Weight of straw and grain:"

Line.

1, *instead* of 23 *read* 22.
2, *instead* of 23 *read* 22.
3, *instead* of 24 *read* 23.
7, *instead* of 31 *read* 30.
9, *instead* of 17 *read* 13.
10, *instead* of 33 *read* 34.
11, *instead* of 29 *read* 28.
12, *instead* of 24 *read* 23.
13, *instead* of 15 *read* 14.
17, *instead* of 20 *read* 19.
18, *instead* of 25 *read* 24.
19, *instead* of 32 *read* 31.

GENERAL INDEX.

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INDEX TO FUNGI.

n. s. following a name indicates a new species, i. e., one described in this volume; *syn.* denotes a synonym.

D.

G.

H.

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X.

Z.

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DIVISION OF VEGETABLE PATHOLOGY.
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